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ABSTRACT

This competency-based prevocational exploration curriculum in agribusiness and natural resources is divided into the following eight areas: agricultural business (sales); animal science (health and grooming); horticulture (grafting and budding); agricultural products (grading eggs); plant science (germination); soil science (soil acidity and alkalinity); agricultural mechanics (small engine maintenance); and natural resources (forestry measurements). The exercises in each area are designed to help the students explore their own interests and attitudes towards careers in these areas and experience some of the tasks that workers might be expected to perform. A teacher's guide (CE 022 471) accompanies this document. (BM)

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ED174838

STUDENT MATERIAL

EXPLORING AGRIBUSINESS AND NATURAL RESOURCES

Competency Based Education Curriculum

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June 1979

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EDUCATION & WELFARE
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PREFACE

This Prevocational Exploration Curriculum in Agribusiness and Natural Resources is one of approximately twenty-five West Virginia developed CBE curriculums. This material was prepared by Layle Lawrence, Agricultural Education Department, West Virginia University, in cooperation with the Bureau of Vocational, Technical and Adult Education, West Virginia Department of Education.

The Bureau began advocating competency-based education curriculum in 1974. Since that time, a great deal of effort has been expended in the development of materials related to prevocational exploration. Currently, curriculum exists in four job cluster areas with another two under development.

This prevocational exploration curriculum was disseminated to West Virginia teachers at the Annual Vocational Teachers Conference at West Virginia University in August 1979.

Additional copies of this material may be obtained from:

Vocational Curriculum Laboratory
Cedar Lakes Conference Center
Ripley, West Virginia 25271
Phone: (304) 372-8673

I trust this curriculum will be of assistance in your program. Any suggestions you may have for improving it may be sent to our State Curriculum Lab. Through this feedback we plan to continually update and revise our materials.

VOCATIONAL, TECHNICAL AND ADULT EDUCATION

Clarence E. Burdette

Clarence E. Burdette
Assistant State Superintendent of Schools

FOREWORD

How do you suppose Columbus felt when, after weeks on the Atlantic Ocean, land was finally sighted?

Imagine Edison's delight when he pulled the switch and the first light bulb glowed!

Dr. Jonas Salk spent years and experienced thousands of failures before control of the dread disease, polio, became a reality through use of his vaccine.

You can have something in common with these three famous individuals. You can be an explorer; you can seek a discovery. You can explore the world of work and discover your own interests and attitudes and ambitions, just as Columbus and Edison and Salk had to do before they charted life's course.

Exercises in this Guide have been designed to help you discover your interests and attitudes towards careers in agriculture and natural resources. These careers may be in farming, in forestry, in science, in education, or in off-farm agricultural business and industry. You will explore and experience some of the tasks that workers might be expected to perform. And you will discover that thousands of jobs exist which require agricultural knowledge and skills.

Hopefully, you will find one or more areas which you will want to investigate further. Your teacher and counselor will help you locate additional information and make plans for getting the education and experience required for career entry.

Even if you decide that a career in agriculture or natural resources is not for you, I hope you find the exercises interesting, useful, and enjoyable.

Layle D. Lawrence
Agricultural Education
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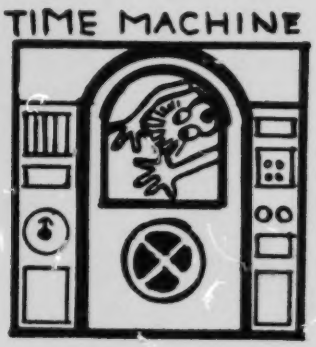
Agricultural Business - Sales

Upon completion of this exercise, you will be able to write sales tickets, issue checks, and prepare advertising copy for an agricultural business. You will also be able to name at least four occupations in which agricultural business skills are useful.

Did you ever hear of a time machine? In science-fiction stories, a person who enters a time machine can be sent forward or backward in time to observe and experience the past or future. Sound interesting? Good!

Today, you are invited to step into a time machine and project yourself ten years into the future. Ready? Close the door. Here we go...



If you pushed the button marked "ten years" and pulled the "future" lever, you are now ready to emerge from the machine. As you step out, you will note that you are now in Agtown, USA. And, much much to your surprise, you have just purchased a business known as Agtown Farm and Garden Supply! Look around the store. Take a quick inventory of products your business sells--feed, seed, agricultural chemicals, livestock equipment, yard and garden tools and equipment, and hardware. Judging from the number of people coming and going, it appears that business is brisk.

Suddenly, the thought occurs--"What will I, as a business owner, have to know in order to successfully operate the business?"

What will you have to know?

9.

This exercise is designed to acquaint you with some of the skills needed by managers and workers in agricultural sales jobs. The field of agricultural sales offers numerous employment opportunities for men and women who are interested and prepared, in both retailing and wholesaling.

Think of any product or group of products sold to agricultural producers and you'll find wholesale representatives involved. For example:

Seeds
Feeds
Fuels and lubricants
Chemicals
Machinery
Tires
Livestock equipment
Greenhouses
Buildings
Fertilizers

Wholesale representatives normally deal with retail distributors. They sometimes sell direct to producers also.

At the retail level, sales personnel may be involved in selling a single specialized product to agriculturalists. But more often they will be dealing with a broader line of products. Your Agtown Farm and Garden Supply, for example, handles a wide variety of products and caters to the commercial farmer as well as to the backyard amateur gardener.

So... Here you are ten years in the future in Agtown, USA, with a thriving farm and garden supply business on your hands. Let's look at some of the skills you must acquire to operate the business successfully.

SALES TICKETS

The sales ticket is one of the most important forms used in a business. The sales ticket becomes a permanent record of each transaction and makes possible an accounting and record-keeping system.

Sales tickets are used by the business owner or manager to determine:

**The amount of cash taken in during the day
**Quantity and type of merchandise sold
**Sales tax collections
**Money owed the business through customers' charge accounts

A sales ticket is simple to make out. Examine the completed sales ticket on the following page. Here's what the numbers mean:

1. Enter today's date
2. Write the customer's name. If you don't know his/her name, ask.
3. The customer's address is important if the purchase is charged (not paid for). You will want to send him/her a bill at the end of the month.
4. Enter quantity (how many items or units).
5. Describe the items sold. Be specific.
6. Enter price per item or per unit.
7. Quantity x Price = Amount
8. Note deviations from retail price, if any. (Examples: quantity discount, damaged merchandise)
9. Enter the amount of discount or deviation from retail price.
10. Subtract discount from retail price.
11. Calculate and enter sales tax (if any). In the example, only rose bushes are subject to sales tax.
12. Enter the total amount of the transaction.
13. If the purchase is a charge account, get the customer's signature on the ticket.
14. The sales person initials or signs the ticket.
15. Indicate the method of payment or type of transaction.

Easy enough, wouldn't you say?

Look over the ticket again. Can you explain why each item recorded is useful or necessary?

AGTOWN FARM AND GARDEN SUPPLY

Agtown, USA 10101

(1) March 7 19 83

Sold to (2) Al Falfa

Address (3) Route 1
Agtown

Quantity	Description	Price	Amount
(4) 100	(5) 50 lb. bags tankage	(6) 8.00	(7) 800.00
	(8) less 5% quantity discount		(9) 40.00
			(10) 760.00
3	Rose bushes	1.50	4.50
	sales tax		(11) .14
		Total	(12) 764.64

Received By: (13) Al Falfa Salesman (14) Your name

Cash	Check	Charge	Returned	Rec. Acct.
		(15) ✓		

No. _____

Sales Tax

Sales tax rates vary from state to state. Some states have no sales tax at all. In most states, sales taxes are charged only on items purchased for personal use. Items purchased for use in a business are exempt from the tax. For example, rose bushes purchased to plant around the home are taxable, but rose bushes purchased to produce cut flowers for sale are not taxed. It is the seller's responsibility to determine if goods are taxable and to collect sales taxes for the state.

Remember--Anything used in production of articles or products for sale is exempt from sales tax.

The following sales tax rate chart from West Virginia, a state with a 3% sales tax rate, may be used to compute sales tax on items costing up to $21.70. On items costing more, multiply the dollar amount times three and add the amount shown in the chart for the remainder up to $1.00.

WEST VIRGINIA CONSUMERS SALES TAX (3%) RATE CHART: EFFECTIVE 7-1-1965 **POST NEAR CASH REGISTER**

AMOUNT OF SALE	TAX
$ .01 TO $ .05	NONE
.06 TO .35	$ .01
.36 TO .70	.02
.71 TO 1.00	.03
1.01 TO 1.35	.04
1.36 TO 1.70	.05
1.71 TO 2.00	.06
2.01 TO 2.35	.07
2.36 TO 2.70	.08
2.71 TO 3.00	.09
3.01 TO 3.35	.10
3.36 TO 3.70	.11
3.71 TO 4.00	.12
4.01 TO 4.35	.13
4.36 TO 4.70	.14
4.71 TO 5.00	.15
5.01 TO 5.35	.16
5.36 TO 5.70	.17
5.71 TO 6.00	.18
6.01 TO 6.35	.19
6.36 TO 6.70	.20
6.71 TO 7.00	.21
$ 7.01 TO $ 7.35	$ .22
7.36 TO 7.70	.23
7.71 TO 8.00	.24
8.01 TO 8.35	.25
8.36 TO 8.70	.26
8.71 TO 9.00	.27
9.01 TO 9.35	.28
9.36 TO 9.70	.29
9.71 TO 10.00	.30
10.01 TO 10.35	.31
10.36 TO 10.70	.32
10.71 TO 11.00	.33
11.01 TO 11.35	.34
11.36 TO 11.70	.35
11.71 TO 12.00	.36
12.01 TO 12.35	.37
12.36 TO 12.70	.38
12.71 TO 13.00	.39
13.01 TO 13.35	.40
13.36 TO 13.70	.41
13.71 TO 14.00	.42
14.01 TO 14.35	.43
$14.36 TO $14.70	$ .44
14.71 TO 15.00	.45
15.01 TO 15.35	.46
15.36 TO 15.70	.47
15.71 TO 16.00	.48
16.01 TO 16.35	.49
16.36 TO 16.70	.50
16.71 TO 17.00	.51
17.01 TO 17.35	.52
17.36 TO 17.70	.53
17.71 TO 18.00	.54
18.01 TO 18.35	.55
18.36 TO 18.70	.56
18.71 TO 19.00	.57
19.01 TO 19.35	.58
19.36 TO 19.70	.59
19.71 TO 20.00	.60
20.01 TO 20.35	.61
20.36 TO 20.70	.62
20.71 TO 21.00	.63
21.01 TO 21.35	.64
21.36 TO 21.70	.65

Let's calculate sales taxes and total costs on a few example problems. Make your calculations on scratch paper.

1. 1 claw hammer @ $7.65

2. 10 lb. 16d nails @ $.15 per pound
   2 gallons housepaint @ $9.00 per gallon

3. 200 lb. 5-10-5 lawn fertilizer @ $7.00 per hundred lbs.
   12 lb. mixed grass seed @ $2.00 per pound

4. 3 evergreen trees @ $12.75 each

Ready to check your answers? See if yours agree with those given below.

1. $7.65 hammer
   .23 sales tax (from tax chart)
   $7.88 total

2. 10 lb. x $ .15 = $ 1.50
   2 gal. x $9.00 = 18.00
   $19.50
   .59 sales tax (from tax chart)
   $20.09 total

3. 200 lb. x $7.00/cwt. = $14.00
   12 lb. x $2.00/lb. = 24.00
   $38.00
   1.14 sales tax ($38 x .03 = $1.14)
   $39.14 total

4. 3 trees x $12.75 each = $38.25
   1.16 sales tax*
   $39.41 total
   *($38 x .03 = $1.14)
   (tax chart .06 to .35 = .02)
   (total sales tax = $1.16)

That wasn't so difficult, was it? With some idea of how sales taxes are computed, let's proceed to the business at hand--sales tickets.

Sales Ticket Examples

You've probably already noticed that sales work requires use of mathematics. Calculations must be accurate or Agtown Farm and Garden Supply may go bankrupt in short order. Besides accuracy in adding, subtracting, and computing sales tax, sales tickets must be written legibly so they can be read.

Ask your instructor for three blank sales tickets. Fill them out completely using the information given in the following examples. You will have to decide which items require payment of sales taxes. Check each one against the sample sales ticket and explanations given earlier, then ask your instructor to check them for accuracy.

Example 1.

Sold to Mrs. Ima Gardner of 110 Radish Avenue, Agtown, on today's date for cash:

2 pair garden gloves @ $2.25 per pair
1 garden trowel @ $3.65
3 bottles Riddo bug killer @ $1.80 per bottle

(hint--if your sales tax charge is not $.41, you've made a mistake)

Example 2.

Sold to Hugo Farmer, Route 8, Agtown, on today's date (charge account):

10 tons 20-20-0 fertilizer @ $80.00 per ton, less 4% early season discount
400 lbs. Poppo seed corn @ $.52 per pound
10 tubes litho gun grease @ $.75 per tube
1 Perko coffee pot @ $17.50

Example 3.

Sold to Green's Nursery, Route 6, Agtown, on today's date (paid by check):

500 ft. 6 mil black plastic @ $.12 per foot
2,000 Jiffy pots @ $.09 each
2 lb. Big Red tomato seed @ $27.50 per lb.
5 lb. Grafting wax @ $2.50 per lb.
1 lb. Kubber budding strips, 4" @ $5.40 per lb.
20 bags peat moss @ $4.50 per bag, less 5% quantity discount

****

That's all. If you can read what you wrote, if your computations were correct, and if you filled out the sales ticket correctly, Agtown Farm and Garden Supply has just made a nice profit!

WRITING CHECKS

One of the cold facts that Agtown Farm and Garden Supply must face is that items purchased for resale must be paid for. Prompt payment of bills will keep you, as owner, in good standing with your suppliers.

Most business debts are paid by check. There are several good reasons for using checks:

**Checks are safer and more convenient to mail or carry than cash.

**A cancelled check provides a permanent record of payment.

**Accounts are more easily kept when checks are used to pay expenses.

Your business checking account has been opened at the Bank of Agtown and sufficient money has been deposited to cover checks you write.

Study the check below which has been written to Growfast Fertilizers, Inc.

Agtown Farm and Garden Supply
Agtown, USA

(1) October 10 1983

Pay to the order of (2) Growfast Fertilizers, Inc. (3) $ 876 42/100

(4) Eight hundred seventy six and 42/100 Dollars

THE BANK OF AGTOWN
Agtown, USA

Memo (5) Invoice #3120 (6) Your Signature

Here are the key steps to follow in correctly writing a check:

1. Enter today's date.
2. Write, print, or stamp the name of the individual or firm to whom the money is to be paid.
3. Enter the exact sum of dollars and cents to be paid, in numbers. The number of dollars is entered in large numbers, the cents in smaller numbers and written in fractions of one dollar (examples: 7 25/100; 112 50/100; 1,003 75/100).

4. Write out the amount of the check. Start at the far left hand margin and spell out numbers of dollars; then write numbers of cents in fraction form again (xx/100). Fill the line completely so that additional numbers cannot be added.
5. This space allows you to make a note of what the check was for. In this example, the check was cross-referenced to an invoice (a bill) from Growfast Fertilizers, Inc.
6. The business owner, manager, or accountant (whoever is authorized) signs the check. The signature must be the same each time a check is written.

Nothing mysterious about that, is there? Just be sure to write legibly and recheck the numbers entered so that no errors occur.

Let's try writing checks! Ask your instructor for three blank checks. Fill them out completely in ink using the information supplied below.

Check Number 1

On today's date, pay Les Toil for 8 hours labor at the rate of $3.30 per hour.

Check Number 2

On today's date, pay Cheaptree Nursery for the following stock on their invoice number 41B760:

300 Blueray Blueberry bushes @ $2.50 per bush
75 Greengage plum trees @ $3.50 per tree

Check Number 3

On today's date, pay Bigwheel Trucking Company for hauling charges listed on their invoice number 328, dated May 30:

May 1 - fertilizer, St. Louis to Agtown, 980 miles @ $.35 per mile.
May 8 - feed, Topeka to Agtown, 720 miles @ $.42 per mile.

When you have written the checks, ask your instructor to verify accuracy of your figures and ask if s/he has suggestions for improvement.

If your checks were correctly computed and written, debts of Agtown Farm and Garden Supply are now completely paid off.

NEWSPAPER ADVERTISING

Advertising can be the life-blood of a business. In order to keep the company name in the public's mind, Agtown Farm and Garden Supply advertises in a number of ways.

**The company letterhead is used on stationery and mailings.
**The company name is prominently displayed on company vehicles.
**There's an attractive sign outside the store.
**Special advertisements appear in local newspapers and over the local radio and television stations.
**Circulars are printed and mailed to selected customers (dairymen, homeowners, gardeners, etc.), depending on items featured.
**Product displays are set up in store windows and on the sales floor.

The purpose of advertising is to increase sales volume and profits. Regardless of the method of product advertising, the advertisement should:

1. Attract attention of potential buyers.
2. Stimulate interest in the prospective customer.
3. Create a desire for the product.
4. Motivate buying action.

The newspaper is a common medium for retail store advertisements. Agtown Farm and Garden Supply relies rather heavily on the Agtown Times to carry sales messages to potential buyers. Newspaper ads are used by your business to:

++Introduce new products
++Reduce inventory
++Promote seasonal products
++Increase slow season sales volume
++Keep the company name before the public

As you prepare newspaper advertisements for Agtown Farm and Garden Supply, keep in mind the five elements of good advertising copy:

1. Headline. The headline must attract the reader's attention and make him/her want to read more. It should be brief, not more than five or six words.

2. Illustration. Nearly everyone likes pictures and is attracted to them. A photo or drawing may show the product itself, special features of the product, or how the product works. Not all ads are illustrated, but more sales may result from an attractive illustrated ad.

3. Copy. This is the sales message. It may stress product benefits and specifications, create desire to own the product, and urge the customer to come in, look, and buy.

4. Layout. The layout or design of the advertisement must be pleasing to the eye. Layout involves careful selection of type and size of type, placement of illustrations, use of white space, and arrangement of copy.

5. Signature Plate. A store's signature plate is usually a distinctive type face, trademark, emblem, or symbol which immediately identifies the store for the reader. It may include the store's address, business hours, slogan, and phone number.

Examine the advertisement below. If you were to give it A, B, C, D, or F grades, how would you rate the headline? illustrations? copy? layout? signature plate?

It's New!

The lightweight Woodchopper Chain Saw

* Powerful 2.8 cubic inch engine
* Self sharpening chain
* Cuts 28 inch diameter trees
* Extra chain and guide bar free
* Only $110 with case

Agtown Farm & Garden Supply

Open 9-5 daily

Look through advertisements in your local newspaper. Can you identify the five elements of advertising copy in each? Find examples of good copy. Are some better than others? In what respect?

****

Now that you are acquainted with the elements of good advertising copy and have observed and evaluated newspaper advertisements, it's your turn to create some ads for Agtown Farm and Garden Supply.

Read and analyze the two situations given below. From the information given, prepare advertisements to be placed in the Agtown Times. Ads can be prepared on 5" x 7" cards or on half-sheets of typing paper. Create your own distinctive kind of print and signature plate.

Advertisement 1.

In the fall of the year (nearly the end of the gardening season), you find that Agtown Farm and Garden Supply has quite a number of power lawn mowers still on hand. To keep them over until next spring will cause storage problems, to say nothing of the money you'll have tied up in them through the winter. As owner of the business, you decide that the best thing to do is to reduce prices by 20% and try to get people to buy them now rather than wait until next spring.

Advertisement 2.

Agtown Farm and Garden Supply has taken on a new line of weedkiller for corn, called "Killem". It will cost $2 to $3 less per acre than your competitor's products. Killem destroys broadleaf and grassy weeds without harming corn. It comes in easy-to-apply granular form, and poses no threat to next year's crop as it is completely biodegradable. Agtown Farm and Garden Supply is the only place in town where Killem is available.

****

When you have completed your advertisements, rate each of the five elements by letter grade: A, B, C, D, or F.

Exchange ads with a fellow student and rate each other's work. Do your ratings agree?

Ask your instructor to rate your work. How closely does s/he agree with your own ratings?

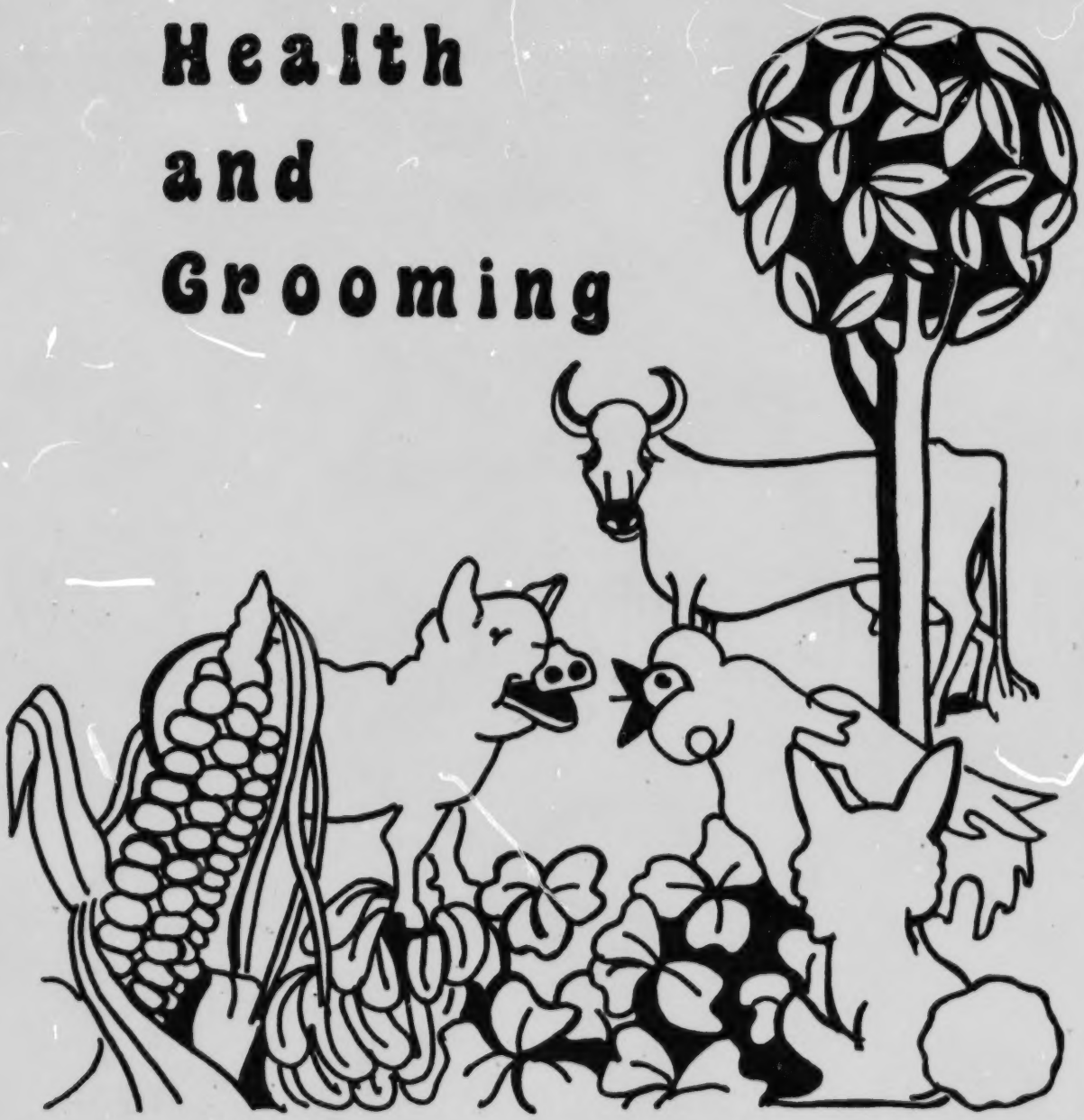
SUMMARY

You have now experienced a few tasks involved in agricultural sales occupations. In larger businesses, the jobs of store manager, sales clerk, advertising manager, and bookkeeper might be held by separate individuals. Other jobs in the agricultural business field include agricultural economists, regional sales managers, fertilizer applicators, and feed formulators, to name just a few.

Jobs are available in agricultural business occupations for those who seriously prepare for them during high school and/or college. If this type of work appeals to you, ask your instructor and counselor for additional information concerning means of preparation and job entry.

ANIMAL SCIENCE

Health and Grooming



Upon completion of this exercise, you will be able to bathe and groom a dog and check its temperature, pulse rate, and respiration rate. You will also be able to name at least four occupations in which animal science skills are useful.

Down through the ages, animals have helped man to survive and prosper. At some time or another, animals have provided:

**Food. Meat and milk are important sources of protein, carbohydrates, vitamins, and minerals.

**Light. Tallow, made from animal fat, is used to make candles.

**Work. Horses, oxen, camels, and buffaloes are used as draft animals in many parts of the world. In the Arctic, dogs pull sleds.

**Clothing. Wool, furs, and leather have been worn since Adam and Eve left the Garden of Eden.

**Shelter. Teepees and other forms of housing have been crafted from animal skins.

**Fuel. Dried cow and buffalo dung is a major source of fuel for many Asians, and was important during settlement of the midwest (USA).

**Companionship. Pets make life more enjoyable for millions of people.

**Fertilizer. Animal bones, meat scraps and manure were major sources of fertilizers prior to the industrial age.

And speaking of animals, did you know...

.... that in ancient Ethiopia (in Africa), tribesmen once crowned a dog as King? Yes, the tribe was ruled by a dog! If the dog King licked the hand of the person before him, that person received great honors. But if the King growled, off went the person's head!

.... largely due to the beaver, American was settled? It was beaver trappers who explored the country and brought back tales of the rich lands in the West.

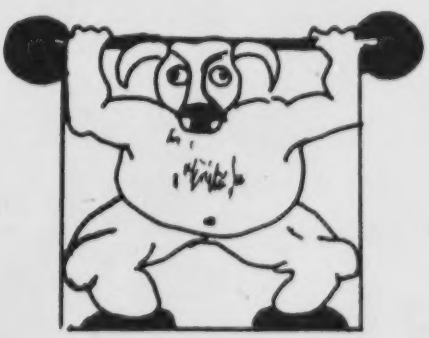
.... the great Chicago fire of 1871, which destroyed a third of the city and in which hundreds of lives were lost, was blamed on a cow? Mrs. O'Leary kept her cow in the barn behind her house. One evening as Mrs. O'Leary was milking, her cow kicked over the kerosene lantern, starting the fire.

.... there were no cattle, pigs, or horses in America when the continent was discovered? The first to arrive in the New World were brought by Columbus to the West Indies on his second voyage in 1493. Cortez, DeSoto, and other Spanish explorers brought horses, pigs, cattle, and sheep with them on each expedition.

.... sheep are timid and defenseless and are the least intelligent and least teachable of all domestic four-footed animals? They are completely dependent upon man for survival.

Our language is colored with terms related to animals. For example:

**Sly as a fox; a foxy lady
**Strong as a bull; bull-headed; bulls-eye
**A dog-eared book; going to the dogs
**Horsepower; horsing around; ponytail
**Stubborn as a mule
**Grinning like a Chessie cat
**Playing possum
**Lionhearted; in like a lion, out like a lamb (March); a lion's share
**Eats like a pig; fat as a hog; graceful as a hog on ice
**A memory like an elephant's
**A rattail file; rat fink
**A wolf in sheep's clothing



Can you think of others?

This exercise is designed to acquaint you with some useful animal science skills. The field of anima? science offers many employment opportunitites for those who are interested and prepared. Some examples:

**Farmers (dairy, swine, sheep, beef, poultry, bees)
**Livestock buyers
**Stockyards employees
**Pet shop owners and workers
**Veterinarians, veterinarian's aides
**Kennel operators and workers
**Animal trainers
**Pet producers
**Pet groomers
**Teachers
**Animal scientists
**Stables operators and workers
**Feed sales persons

To complete the exercise, you and your classmates will have to bring dogs to school. You will probably need one period to check the dog's health and cut its nails; another period will be needed to bathe and groom the dog.

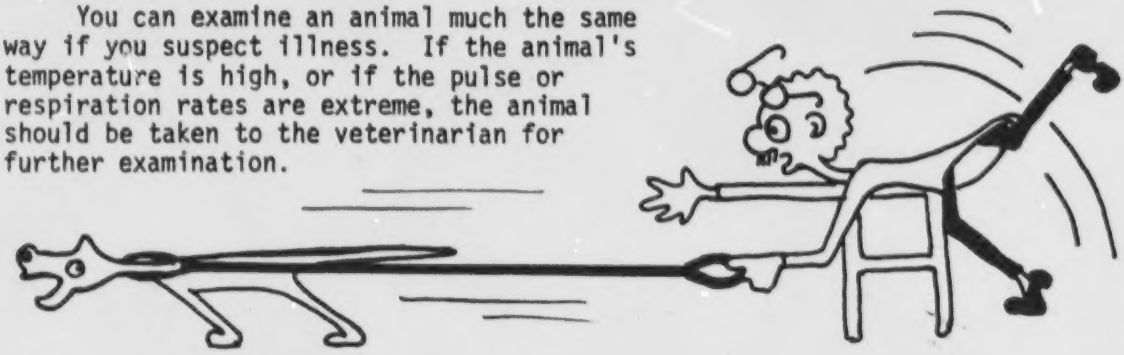
Be sure the check out a muzzle and a leash from your instructor. Even though your dog has never bitten anyone, use the muzzle as a preventive measure. It is painless to the dog.

Read through the exercise before you bring your dog to school so that you have some idea of what you're to do.

PULSE, RESPIRATION, AND TEMPERATURE

When you go to a doctor for an examination, what are the first things he does? Normally, s/he will check your pulse rate, take your temperature, and listen to your breathing and heartbeat with a stethoscope. These three observations give the doctor an idea of your general health.

You can examine an animal much the same way if you suspect illness. If the animal's temperature is high, or if the pulse or respiration rates are extreme, the animal should be taken to the veterinarian for further examination.



Study the table below. It lists normal temperatures, pulse rates, and respiration rates for farm animals, dogs, and cats. Normal readings are taken when animals have been at rest for some time and are not unduly excited.

Animal	Normal Rectal Temperature		Normal pulse rate per minute	Normal respiration rate per minute
	Average	Range		
Cattle	101.5	100.4-102.8	60-70	10-30
Sheep	102.3	100.9-103.8	70-80	12-20
Swine	102.6	102.0-103.6	60-80	8-13
Horse	100.5	99.0-100.8	32-44	8-16
Dog	101.5	101.0-102.0	60-120	30-40
Cat	101.0	100.5-101.5	60-120	25-30

Note the differences among animals. Which has the highest temperature? the lowest?

Pulse rate is linked to length of life--an animal with a slow pulse rate is likely to live longer than one with a rapid heartbeat. Which animal named in the chart is likely to live longest?

Respiration rate depends somewhat on lung capacity. Which animals would appear to have the greatest lung capacity in relation to their body sizes?

What is your own normal pulse and respiration rates and temperature?

Your Dogside Manner

Doctors who are able to make patients feel comfortable and at ease are said to have a good "bedside manner." Dogs, and other animals, are much easier to work with when they, too, are relaxed and at ease.

In this exercise you will be measuring temperature, pulse rate, and respiration rate of a dog. You will also clip its toenails and bathe the animal. All these activities are painless. But dogs often get excited and may even bite when faced with an unfamiliar situation (like people sometimes bite their dentists). In working with dogs, be sure to follow these rules:

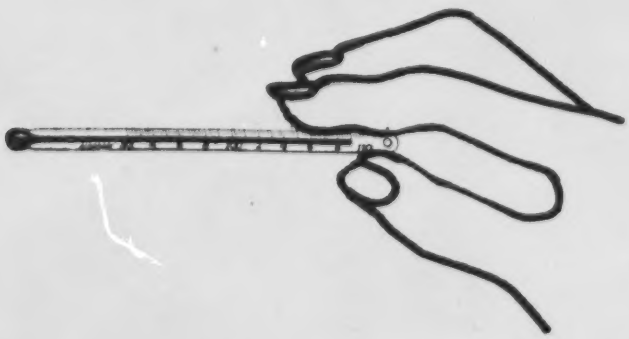
- **muzzle the dog
- **be gentle
- **talk to the dog to reassure him
- **pet the dog
- **allow the dog to investigate the handler
- **never surprise the dog, make no sudden movements

Taking Temperature

An animal's body temperature is an indicator of health. Fever is often the first easily detected sign of infection or disease. Temperature is helpful in diagnosis of a disease and in observing its course.

What happens when you tell your mother you don't feel like going to school? She probably either feels your forehead for signs of fever or pops a thermometer in your mouth. In either case, she is attempting to decide whether you are really sick or maybe just sick of school.

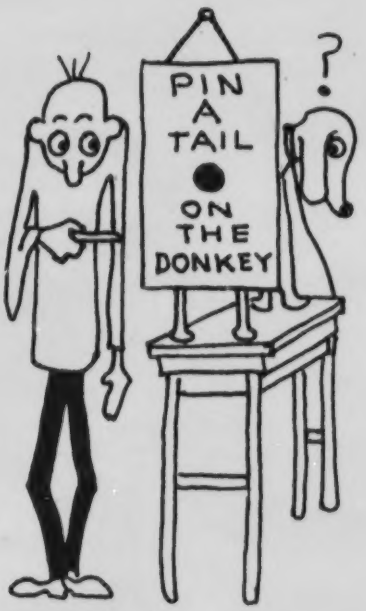
The instrument used in taking an animal's (or a person's) temperature is called a maximum thermometer. When the bulb is warmed, mercury rises in the column and remains at its highest (maximum) reading.



Because mercury in the thermometer stays at its maximum reading, it must be forced down into the bulb before use. Grasp the end opposite the bulb and shake in a downward motion. Hold tightly to the thermometer so that it doesn't slip from your fingers. Being made of glass, thermometers will break rather easily.

Here's how to take your dog's temperature:

1. Shake the mercury down into the bulb.
2. Lubricate the bulb and about an inch of the thermometer with vaseline.
3. Lift the dog's tail and gently insert the thermometer into the rectum, leaving about 1" remaining outside. Hold the tail so that the thermometer cannot be dislodged or broken.
4. Leave the thermometer for three minutes.
5. Remove the thermometer, wipe it clean with tissue or a paper towel.
6. Read the thermometer. Rotate it until you can see the column of mercury and the numbers at the same time.
7. Disinfect the thermometer by wiping it with a tissue or cotton soaked in alcohol.



Was the dog's temperature high, low, or normal? Check with your instructor to make sure you're reading the thermometer correctly.

Based on your reading, would you say the dog is healthy or sick?

Respiration Rate

To respire is to breathe. Thus, respiration rate is the speed of breathing. To determine respiration rate, count the number of times the dog's chest expands (from inhalation) in one minute. To save time, you could count for 30 seconds and multiply times two to get rate per minute.

What is the normal respiration rate for dogs? Is your dog normal? If the dog has been running, or is quite excited, the rate may be high and should be disregarded. Use your best dogside manner to avoid excitement.

Pulse Rate

Speed of heartbeat is another indicator of general health, and is used in diagnosis of ailments. To check your dog's pulse rate, stand to its right-rear side. With your right hand, gently grasp the right rear leg at the flank. With your fingers on the inside of the flank and leg, you should feel the pulse.

Count the heartbeats for one minute to find pulse rate. Or you may count for 30 seconds and multiply times two.

Is the pulse rate normal? An excited dog will have a high pulse rate. Be sure the dog is calm and relaxed when pulse rate is checked.

CLIPPING NAILS

House pets seldom wear their nails down enough to avoid the necessity of having them cut. Even outdoor dogs occasionally require this service. The average dog's nails need cutting every four to six weeks.

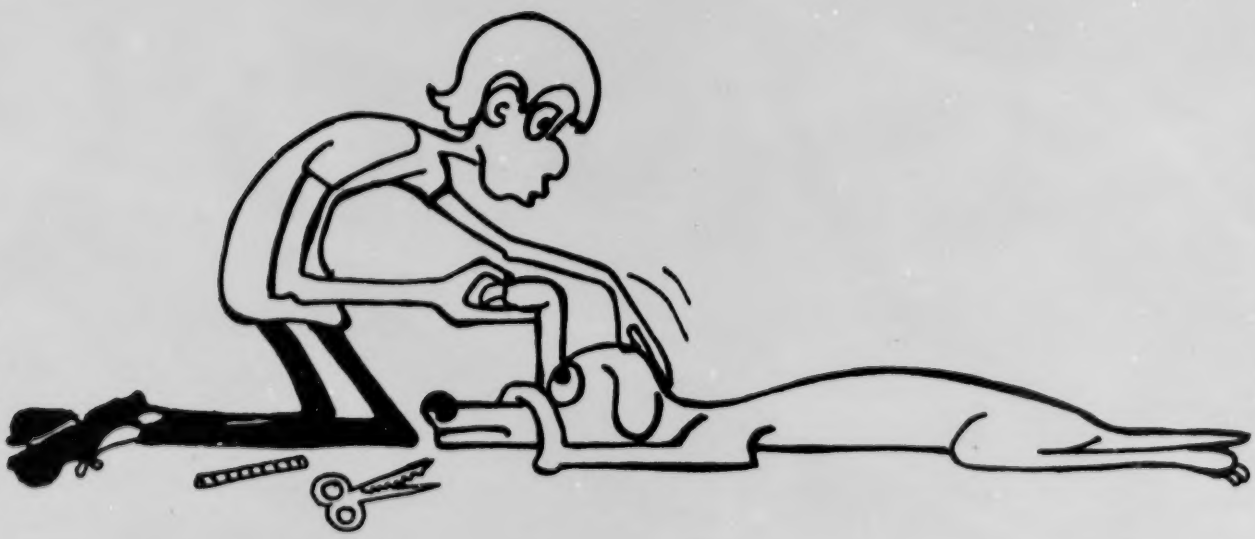
If nails are allowed to grow too long, they force the animal to walk flatfooted. Pounding of the nails on hard floors or pavement is extremely painful to the dog, and is a common cause of lameness.

Check your dog's feet. If the nails are grown out, trim them with a nail trimmer or toe nail clipper. Clip toenails to a point just beyond the quick, the live pink flesh within the nails. The quick is easily seen if the dog has clear nails. If nails are black the quick is easiest to locate from the underneath part of the nail where it has a soft, spongy appearance.

Shortening nails by clipping is sufficient, but if you want to improve the dog's appearance they may be filed after clipping with a small mill file. Draw the file from the top of the nail downward in a rounded stroke. Considerable pressure may be needed the first stroke or two to break through the tough, polished surface of the nail.

LONG TOENAIL TOENAIL CLIPPED TOENAIL CLIPPED AND FILED

Dogs are not fond of having their toenails clipped. Be sure to muzzle the dog before starting the job and restrain him gently but firmly during the operation. It really doesn't hurt the dog at all (does it hurt to clip your own toenails?). To a dog, though, clipping nails is a mighty scary operation.



BATHING AND GROOMING

Bathing

Most dogs believe that taking a bath is unnecessary. You've probably known people like that, too. But occasional bathing aids health and cleanliness (and sometimes smell) of the animal. Bathing more often than every two or three weeks can damage the dog's hair and skin, however.

If your dog hasn't had a bath for some time, here's how to do it:

1. Wet the coat thoroughly with warm water, either in a tub or with a spray. Keep water out of the face and ears.

2. Using a germicidal soap (like Dial), lather the coat working the suds through the hair to the skin with your fingers. Old Shep will like this part of the bath! Again, keep soap out of the face, eyes, & ears.

3. Rinse soap out of the hair. This will call for at least two changes of water in a tub. Remove all traces of soap.

4. Dry the animal with rough towels or dry burlap. Rub vigorously. Don't neglect to dry between the toes.

5. Finish drying with a hair dryer. Hold the dryer about six inches away from the hair.

6. If weather is cold, keep the dog inside for several hours after drying. We don't want it to get pneumonia.

Brushing and Combing

After bathing and drying, the dog's hair should be combed and brushed. If your dog has long hair that is matted, use a Knot Remover to separate mats and tangles, then comb and brush.

Long-haired dogs require a comb with heavy teeth set wide apart. A finer comb is better for short-haired dogs. Never try to comb a long-hair dog while the hair is wet. Comb the hair in the direction it naturally lays.

After combing, brush the coat thoroughly. A long-bristled stiff brush is needed for long-hair dogs. Short-hair or lightly coated dogs can be groomed with a stiff (human) hair brush.

A hound glove works wonders for dogs whose hair lays flat to the body (setters, spaniels, and smooth-coated dogs). The hound glove can be used instead of a brush.

Use a dull pointed scissors to trim hair on the feet and between the toes, and to straighten lines of the ears, legs, and stomach.

Brushing is more important to the condition of your dog's coat than bathing, especially in cold weather. Frequent brushing will remove dirt and loose hair, stimulate growth of healthy hair, and add luster to the coat.

Now, stand back and admire your work. Doesn't Old Shep (or Lassie) look pretty!! And s/he loves you for caring. That makes it all worthwhile.

In this exercise, you have learned skills that people who work with livestock and pets must know. If you enjoy working with animals and are interested in finding out more about animal science occupations and training opportunities, visit with your instructor and counselor.

HORTICULTURE

Grafting & Budding

Upon completion of this exercise, you will be able to make splice and whip grafts and set T-buds. You will also be able to name at least four occupations in which horticultural skills would be useful.

Mr. Goodguy's vocational agriculture class was studying fruit production. Several students had expressed interest in planting orchards when Terry Twig spoke up. "Whatever you do," he said, "don't buy your trees from the Larkspur Nursery. Their trees are no good."

"Why do you say that?" asked Mr. Goodguy.

"We bought six Redheart plum trees from them four years ago. They bloom every year but have never produced a plum," explained Terry.

"Do you have other plum trees?" asked Mr. Goodguy.

"No," said Terry. "That's all we had room for in our back yard."

"Does anybody else in class have plum trees?" asked Mr. Goodguy.

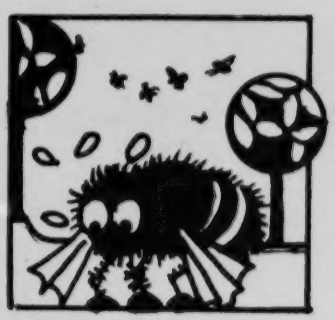
"We have three different kinds," said Tracy Bloom, "and they all produce well."

"Can anybody explain why Terry's trees do not set fruit?" Mr. Goodguy asked the class.

Nobody could.

Can you?

Here's how Mr. Goodguy explained the problem. "Fruit results from pollination of blossoms. Some trees set fruit with their own pollen. They are called 'self-pollinating' trees. Other trees need pollen from another variety. This is called 'cross-pollination' and is done by bees and the wind which carry pollen from one tree to another. Most apples, plums, and sweet cherries need cross-pollination. Terry, your Redheart plums need pollen from another variety of Japanese plums in order to set fruit."



"But what can I do now?" asked Terry. "We don't have room for another tree, and I'd hate to remove one of our trees if they are O.K."

"How would you like to have two or three different kinds of plums growing on each of your trees, Terry?" asked Mr. Goodguy.

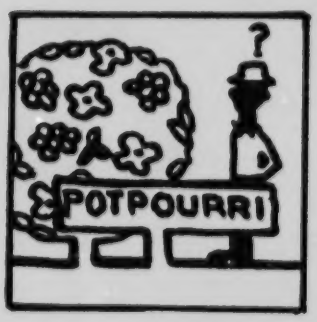
"That would be great," said Terry, "but I don't think it can be done."

"Not only can it be done," said Mr. Goodguy, "but we can solve your problem by grafting branches or buds of different varieties onto the trees you have. Blossoms from the original trees and the grafted branches will then pollinate each other."

****

Grafting and budding are means of uniting a part of one plant with a part of another plant. It is the union of a root and a stem; or the union of two separate stems (branches); or the union of a bud with a stem.

Nearly all fruit trees and many ornamental plants, such as roses, are propagated through grafting--a desirable plant is grafted or budded to a seedling rootstock. In some cases, branches of different varieties are grafted to a single tree. The part of the plant below the graft continues to produce wood and fruit as it did before it was grafted. The part of the plant above the graft produces fruit and wood like that of the plant from which it was taken.



Grafting makes possible:

--propagation of plants difficult to propagate by other means

--changing of undesirable varieties to desirable varieties

--use of root systems resistant to cold or soil pests

--repair of damaged plants

--several kinds of fruits or flowers on the same plant

Budding and grafting are horticultural skills which are useful to:

**farmers and orchardists

**nursery workers

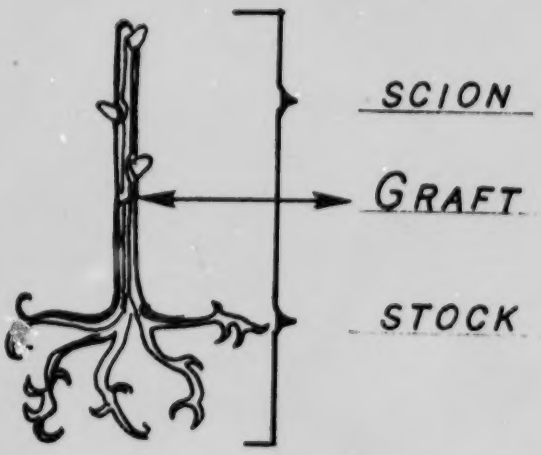
**greenhouse workers

**landscape gardeners

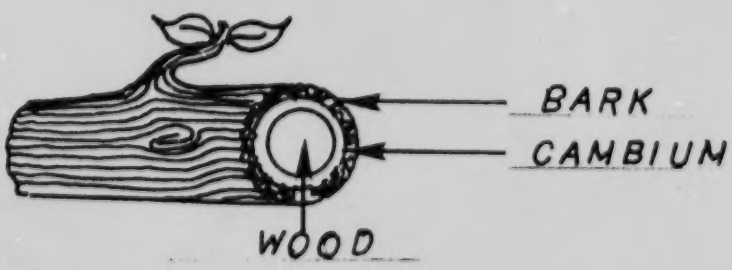
**and many others interested in plant propagation

GRAFTING

In grafting, one plant part is cut and removed from its parent plant. This stem or graft wood which contains one or more buds is called the scion (pronounced si'un). The plant that receives the scion is called the stock.



For a graft to be successful, the cambium layers of scion and stock must meet and be held together until the cells unite. The cambium is the layer of soft tissue between the bark and the wood. It is the cambium which produces new growth in a woody plant.



If cambium layers of the stock and scion are in contact and the scion is held firmly in place without drying out, the union should be successful. Through cell division in the cambium, the two pieces gradually grow together.

There are several different types of grafts. In this exercise, you will learn to make two of the common types. You will be using sharp knives to make cuts. Be very careful. Always cut away from your fingers. Do you know where the first aid supplies are located in case of cut fingers?

To complete the grafting exercises, you will need:

**scion wood (pencil diameter)

**a sharp knife

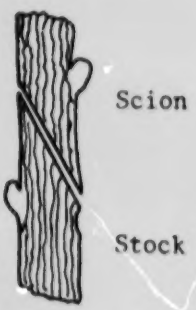
**grafting tape or rubber budding strips

**tree wound dressing or grafting wax

Splice Grafting

Splice grafting is the simplest grafting technique. Follow the directions and observe the illustrations to make a successful graft:

1. Select two pieces of scion wood of approximately the same diameters. Designate one piece as stock, the other as scion. Scion wood should always have one or more buds.



2. Make diagonal cuts of equal length (about twice the diameter of the stock) on both the stock and scion. Cut away from your fingers with the knife.

3. Fit the two parts together. If they do not fit well, recut one of the pieces to fit the other.

4. Tie the graft in place with grafting tape or a rubber budding strip.

5. Coat the grafted area, including the grafting tape, with tree wound dressing or grafting wax. (This step may be eliminated in practice but must be done in actual grafting to prevent the graft from drying out.)

6. Practice splice grafting until it becomes easy.

Did you have trouble holding the two pieces together while starting the tape or rubber budding strip? You will find that the longer the diagonal cuts, the easier it will be to hold them in place.

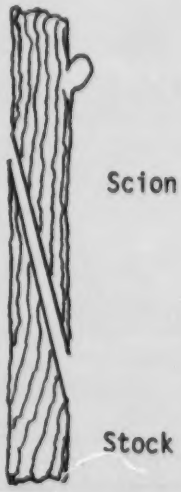
When you feel you can make a satisfactory splice graft, have your instructor check your work.

Whip Grafting

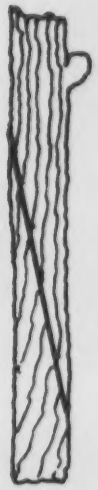
This is the most widely used grafting technique. Because of the large amount of cambium contact, the wound heals quickly and makes a strong union. Here's how to whip graft:

1. Select two pieces of wood of equal diameter for stock and scion.

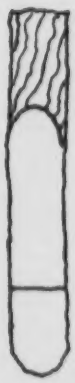
2. Make a long diagonal cut on each piece. The cut should be 4 or 5 times as long as the diameter of the wood.



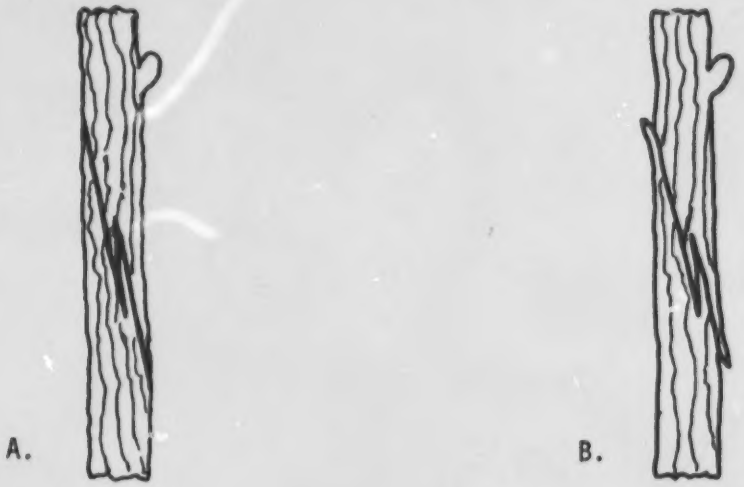
3. Fit the stock and scion together. If they do not fit well, recut one to fit the other.



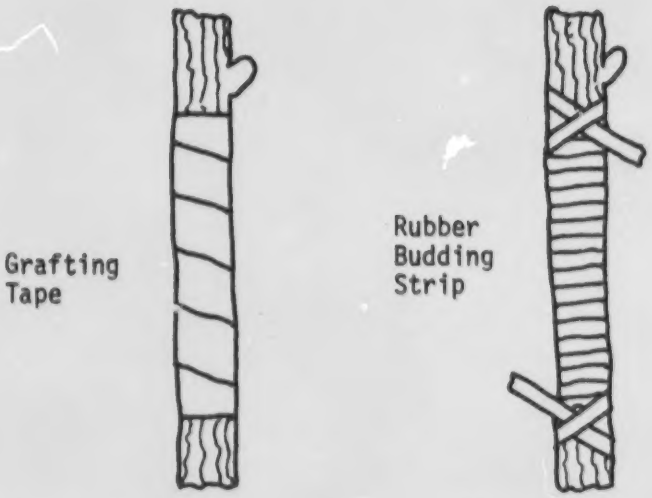
4. On the sloping cut surface of the scion, about one-third the distance from the tip, carefully make another cut nearly parallel to the first, making it from 1/2 to 3/4 inch long. Make a similar cut in the stock.



5. Fit the two pieces together, the tongues interlocking. Some overlapping, as in B below, is allowable.



6. Tie the graft in place with grafting tape or wrap with a rubber budding strip.



7. Coat the grafted area with tree wound dressing or grafting wax. You may want to omit this step in practice, but it must be done in actual grafting to assure success.

8. Practice whip grafting until it becomes easy. Have your instructor check your work when you feel you've been successful.

Grafting is normally done during the dormant season, preferably in late spring. After grafting, scion wood is generally cut off about an inch above the first or second bud, and the cut end is also coated with tree wound dressing or grafting wax.

The two grafts you have learned to make may be used to replace the top of a seedling tree with a desirable plant. Scions from one tree may also be grafted onto branches of another tree. This explains how one tree may produce fruit of several different varieties.

BUDDING

Budding is a type of grafting in which a single bud (the scion) is attached to the stock. This is the primary method used by nurserymen in the propagation of fruit trees. Budding is limited to the period of summer when the bark separates easily from the wood. This normally occurs from June through September.

Buds can be grafted to seedling trees or to branches of more mature trees. Buds are taken from the current year's growth. Stock should be from 1/3 to 1/2 inch diameter for best results. To practice T-budding, you will need the following:

**bud sticks and stock

**knife

**rubber budding strips

Here's the procedure to follow:

1. Select a straight portion of stock, 1/3 to 1/2 inch diameter, free from scars and buds.

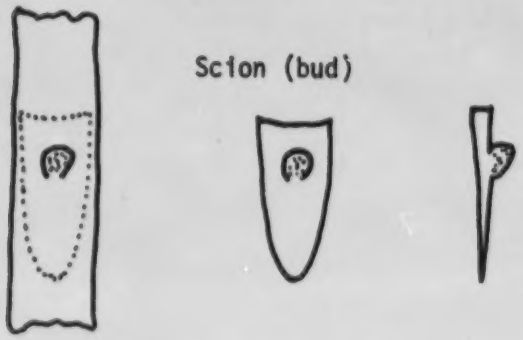
Stock

2. Make a T-shaped cut through the bark on the stem. The horizontal cut should be about 3/8 inch long, the vertical cut a little more than one inch long.

3. Carefully raise the corners of the bark at the top of the T with the point of your knife (this separates bark from the wood).

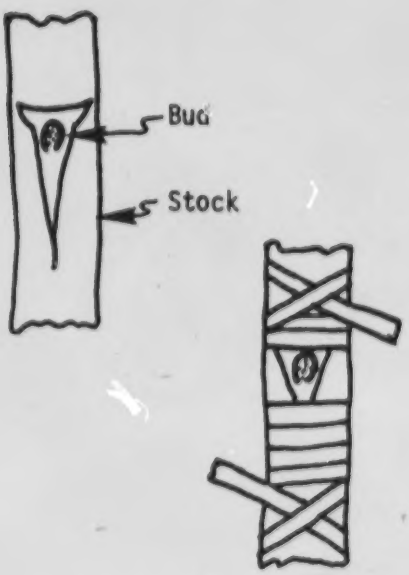
Corners of T loosened

4. Cut a bud from the budwood. Make a horizontal cut through the bark about 1/2 inch above the bud. Then, beginning about 1/2 inch below the bud, make a slice of bark, bud, and wood up to the horizontal cut.



5. Push the bud down into the T-cut on the stock until the top is even with the horizontal cut.

6. Wrap the graft with a rubber budding strip leaving only the bud exposed.



And that's all there is to it! If the bark doesn't slip easily, it may help to loosen the bark all along the vertical cut on the stock with the knife point. Practice budding until it becomes easy, then ask your instructor to check quality of your work.

SUMMARY

Budding and grafting are methods of producing desirable plants, or of creating novelty plants by having several types of flowers or fruits on a single plant. For the graft or bud to grow, the scion and stock must be related. Grafting skills are essential for workers in greenhouses, nurserys, orchards, and grounds maintenance. Other horticultural skills are needed by florists, plant breeders, vegetable producers, and landscape architects.

If working with vegetables, fruits, and/or flowers interests you, discuss your interest with your instructor and counselor. Careers in horticulture are available to high school and college graduates who prepare for them.

AGRICULTURAL PRODUCTS

GRADING EGGS

Upon completion of this activity, you will be able to classify eggs by grade and weight, and name at least four occupations in which agricultural products processing skills are useful.

Imagine going to the grocery store to buy a dozen eggs. No big deal, right? But upon arrival you find that instead of eggs being neatly packed in cartons, you have to select your dozen from hundreds of loose eggs on a counter. Eggs on the counter may be large or small. They may be clean or dirty. They may be whole or cracked. Shells may be rough or smooth. And they may be fresh, a week old, or rotten (rotten eggs are the worst kind!!).

Which eggs will you select? How will you know they are fresh? Maybe you will decide to forget the whole thing and do without eggs!

Eggs are packed in cartons according to grade and weight so that the consumer need not worry about freshness or quality. People who should be familiar with egg grades and weights would include:

**The egg producer. His/her profits depend upon production of clean, high quality products.

**The egg buyer and processor. He/she must determine a reasonable price to pay for the producer's eggs and still be able to make a profit when they are sold.

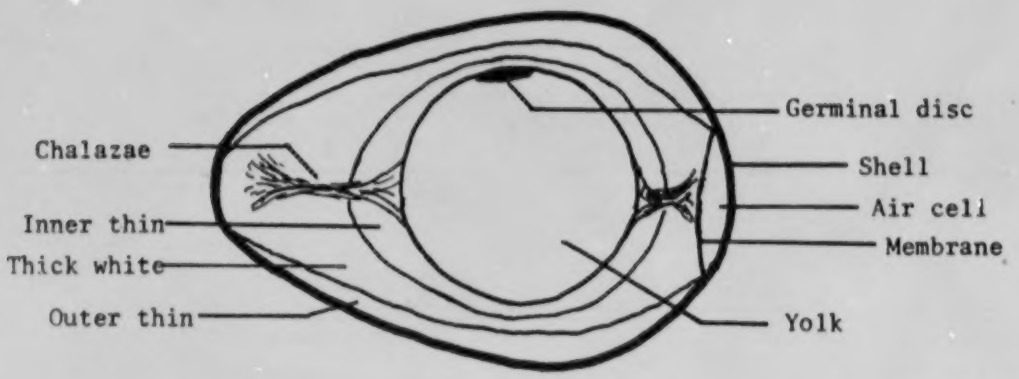
**Egg graders and packers. They are well-paid for sorting eggs according to grade and weight (a service for the user).

**The consumer. Whether it be a bakery, a restaurant, or the homemaker, each should know exactly what is being paid for.

****

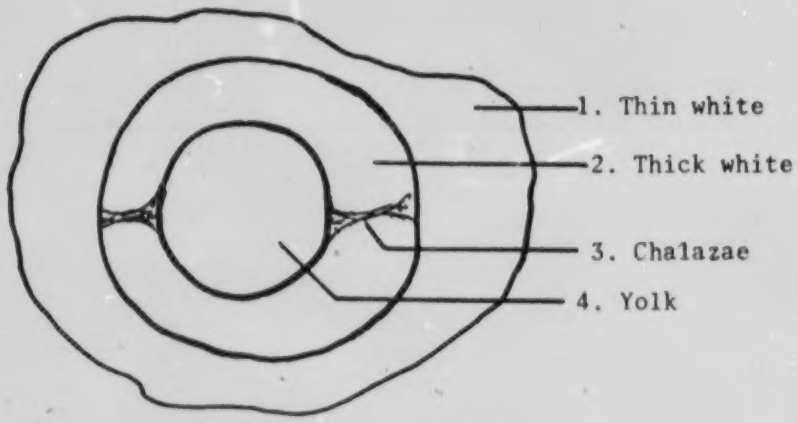
The egg is one of the most nutritious and versatile of human foods. It is an outstanding source of protein. It contains nearly all the known vitamins except vitamin C. And it is an excellent source of minerals--iron, phosphorus, sulphur, potassium, calcium, and others. Besides all that, the egg comes in a neat, convenient package!

Let's get acquainted with this wonder of nature. Study the diagram below so that you know the major parts of an egg.



Certain parts of the egg change as the egg ages. These changes affect quality and grade. For example, the fresh egg has a small air cell, a firm yolk suspended in the center of the egg, and a lot of thick white. As the egg ages, the air cell enlarges, the yolk becomes less firm and is allowed to swing off center, and the thick white becomes thin and runny. Storage in a cool environment, such as your refrigerator, slows the process of quality deterioration.

Ask your instructor for an egg. Break it onto a sheet of plastic or a plate on a flat table or desk top. Can you identify the parts?



Is the egg fresh or not? If the white is thin and runny and the yolk is flat (or easily broken), the egg is not very fresh. If you look closely at the yolk, you may find the germinal disc. The germinal disc is where the embryo chick develops in a fertilized egg.

Look inside the shell. Can you find the membrane and the air cell? The air cell will be in the large end of the egg. A small air cell indicates a fresh egg. Is the outside of the shell smooth? Or does it have ridges or thin spots? Is it clean? All these factors influence egg grades.

GRADING EGGS

Egg grades are based on:

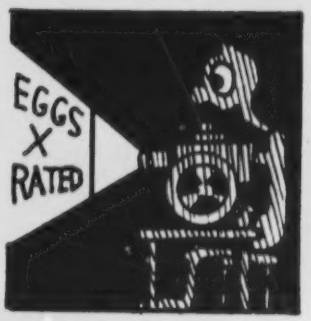
**Exterior quality factors, such as cleanliness and condition of the shell.

**Interior quality factors, such as condition of the white and yolk, and size of the air cell.

Eggs are also classified according to weight, expressed in ounces per dozen. Size of the egg has nothing to do with quality or grade, but does influence buyer preference and price.

Grading, then, is a method of grouping eggs into uniform lots according to quality and weight. Grade characteristics are established by the United States Department of Agriculture.

Before grading exercises are attempted, view the filmstrip "U. S. Standards for Quality of Eggs." Observe closely exterior and interior factors which affect egg quality and grade. Ask your instructor for the filmstrip or find it in your school's learning center.



Finished? Ready to try your skill at grading? Here we go!!

Exterior Quality

Ask your instructor for a dozen eggs and an Exterior Quality Worksheet. Examine each egg and rate it according to the following standards:

**Shell shape and texture

AA or A quality. Normal or practically normal in shape. No ridges, rough areas, or thin spots.

B quality. Slightly abnormal shape, showing definite ridges or slightly rough shell, no thin spots.

C quality. Abnormal shape, pronounced ridges, thin spots, rough areas.

**Shell soundness

AA or A quality. No cracks or checks.

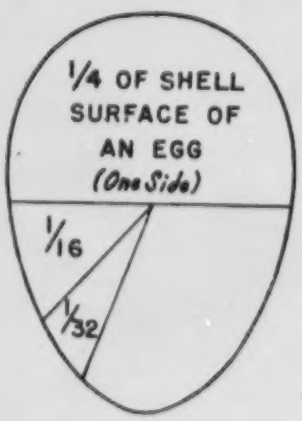
B quality. No cracks or checks.

C quality. No cracks or checks.

Check. Checked or cracked but not leaking.

Leaker. Broken so contents are leaking.

**Shell cleanliness



AA or A quality. Clean. May have very small stains or specks.

B quality. Free from adhering dirt, slight stains which are not especially distracting (1/32 to 1/16 of surface stained).

C quality. Free from adhering dirt, stains of moderate degree covering 1/16 to 1/4 of shell surface.

Dirty. Shell unbroken with adhering dirt, prominent stains, or moderate stains covering more than 1/4 of shell surface.

The egg is placed into the lowest grade occuring in any of the three exterior quality factors--shape and texture, soundness, and cleanliness.

When you have graded the dozen eggs, ask your instructor to check your ratings.

Were they all right? If you got at least 10 of 12 correct, you're well on your way to becoming a licensed egg grader.

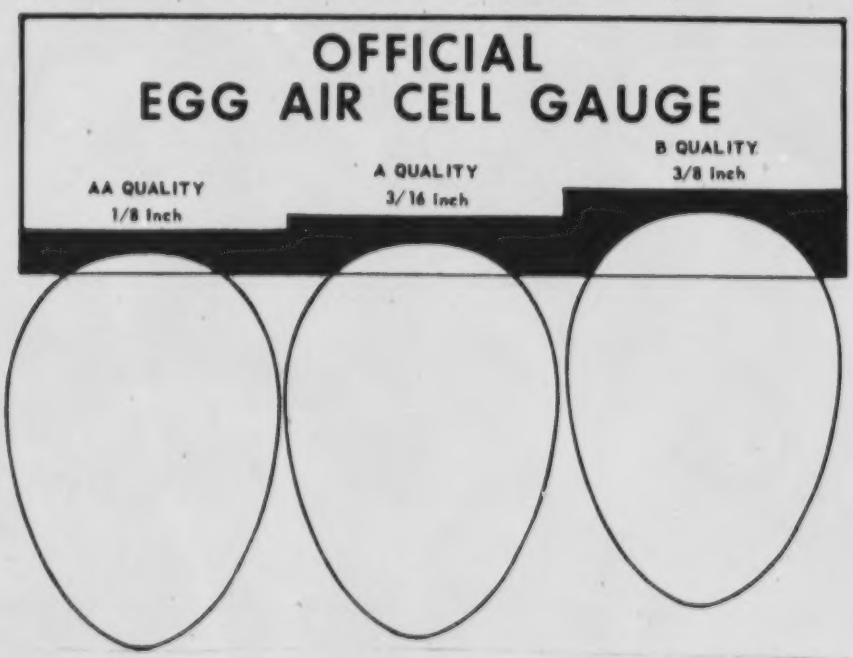
****

Interior Quality

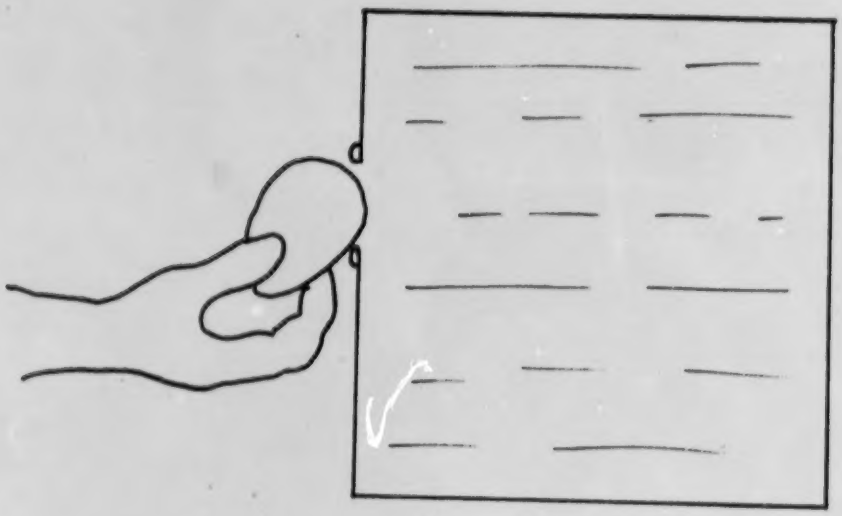
Interior quality is a little more difficult to rate than was exterior quality because we cannot see inside the egg shell. And if we broke all the eggs to grade them, it would be a tedious job putting the contents back into the shells (remember Humpty Dumpty?).

As you noted in the filmstrip, egg contents can be judged by holding the egg near a light to get an idea of what's inside. This process is called "candling." If you don't remember what eggs look like when candled, it may be a good idea to review the filmstrip again.

To judge interior quality, you will need eggs (of course!), a candler, an Interior Quality Worksheet, and an air cell gauge. You can make your own air cell gauge by tracing the pattern below on white paper, pasting it onto thin cardboard, and cutting it out with scissors.



In candling, hold the egg between the thumb and index finger with the small end tipped down at about 45 degrees toward the palm of the hand. As the egg is held up to the candler, rotate the wrist to turn the egg about 180 degrees, then stop. This causes the contents to spin inside the shell. The candler should be at about elbow height in a slightly darkened room.



Do you have the candler?

Interior Quality Worksheet?

Air cell gauge?

Eggs?

Rate each egg according to the following standards:

**Air cell depth

AA quality. Up to 1/8 inch.

A quality. 1/8 to 3/16 inch

B quality. 3/16 to 3/8 inch.

C quality. No limit.

**Yolk condition

AA quality. Yolk centered, indistinct, blends into white as egg is twirled.

A quality. Yolk outline discernable but not well defined, fairly well centered, no defects.

B quality. Yolk outline quite definite and distinct as egg is twirled, may show definite but not serious defects.

C quality. Yolk may be off center, outline plainly visible as egg is twirled, appears enlarged, may show spots but no blood.

Inedible. Yolk shows blood caused by development of germ in fertile egg (an embryo chick).

**White condition (Condition of white is determined by intensity of yolk shadow and movement of yolk as egg is twirled. Thick white (fresh egg) allows little yolk movement and an indistinct shadow results)

AA, A, and B quality. White free from discolorations or foreign bodies floating in it.

C quality. Small (1/8 inch or less) blood spots floating in it.

Loss. Blood is diffused throughout the white.

Again, the egg is placed in the lowest grade found in checking air cell depth, yolk condition, or white condition.

Ask your instructor to check your placings. If they were all right, you are a candidate for a USDA position as a grader-inspector.

The Final Grade

You have now graded eggs according to exterior and interior qualities. Both factors must be considered in determining the final classification.

For this final grading exercise, you will need a Grading Worksheet, the candler, an air cell gauge, and a dozen eggs.

When you're ready, here's what to do.

Examine each egg and grade it for exterior quality. Then examine and grade each egg on interior quality factors. The final grade for each egg will be the lowest of the two grades assigned.

Feel free to use the notes in this Guide to determine exterior and interior grades. You are not expected to memorize classification factors.

****

When you have finished, have your instructor check your grades. If you got 10 or more correct, you get the "good egg" award! Cut it out of construction paper and pin it to your shirt or lapel.

Classification by Weight

At some point in the grading process, eggs are sorted and classified by weight. Use of egg scales makes this a very simple task. By weight, eggs are classified as:

**Jumbo	(minimum of 30 oz./dozen; 2.42 oz. each)
**Extra Large	(minimum 27 oz./dozen; 2.7 oz. each)
**Large	(minimum 24 oz./dozen; 1.92 oz. each)
**Medium	(minimum 21 oz./dozen; 1.67 oz. each)
**Small	(minimum 18 oz./dozen; 1.42 oz. each)
**Peewee	(minimum 15 oz./dozen)

You needn't worry about the mathematics involved here. The egg scale which you will use makes those calculations for you.

Ask your instructor for the egg scale, a Weight Classification Worksheet, and a dozen (or more) eggs. Weigh each egg and place it in the proper weight classification.

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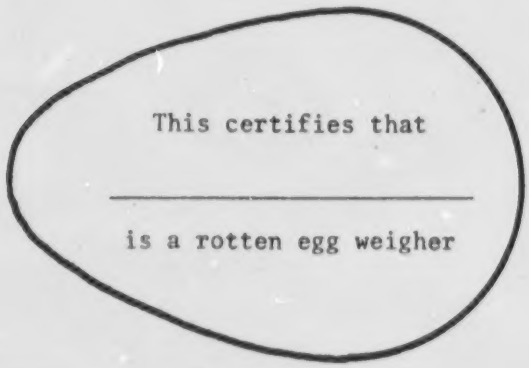
Finished? Easy job, wasn't it? Sometimes it's nice to get the easiest job last.

Have your instructor check your classifications. If you missed <u>any</u>, you, too, get an award. Wear it humbly!



THE AGRICULTURAL PRODUCTS PROCESSING INDUSTRY

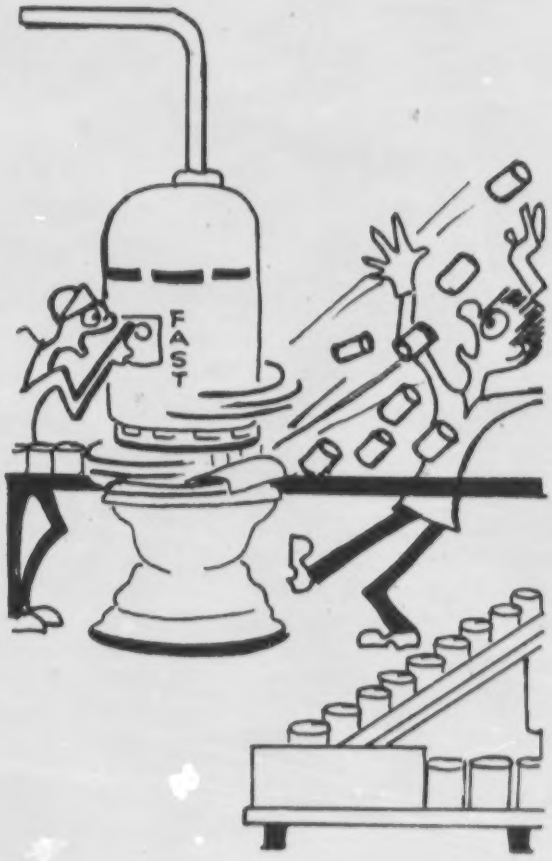
You have now experienced some of the tasks involved in the job of grading eggs, part of the agricultural products processing industry. Processing refers to the operations and changes food products undergo from the time the product is produced until it is sold to the consumer. Other processing jobs involve:

**Meats, Fish and Poultry
- Slaughterhouse worker
- Retail meatcutter
- Fish cannery worker
- Fish cutter
- Poultry picker
- Poultry inspector

**Fruits, Nuts and Vegetables
- Fruit grader
- Citrus processor
- Nut tester (test clerk)
- Nut sanitarian
- Vegetable buyer
- Food technologist

**Grains
- Grain inspector
- Flour miller
- Mill maintenance worker
- Cereal processor

**Dairy Products
- Milk processor
- Dairy plant worker
- Ice cream maker
- Laboratory technician
- Dairy products salesman



If you are interested in food processing occupations, the industry needs you! Jobs are available to those who prepare for them. Preparation may take place in high school, college, or on-the-job.

If you would like information concerning opportunities in agricultural products processing, check with your instructor and counselor.

EGGS

Exterior Quality Worksheet

In each column below, record the grade you believe is correct for each egg.

Egg Number	Highest grade according to			Lowest Grade Noted
	Shell Shape and Texture	Shell Soundness	Shell Cleanliness	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Grades are:

AA
A
B
C
Dirty (cleanliness only)
Check (soundness only)
Leaker (soundness only)

EGGS

Interior Quality Worksheet

In each column below, record the grade you believe is correct for each egg.

Egg Number	Highest grade according to			Lowest Grade Noted
	Air Cell Depth	Yolk Condition	Condition of White	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Grades are:

AA
A
B
C
Inedible (yolk condition only)
Loss (white condition only)

EGGS

Grading Worksheet

Grade exterior quality and interior quality of each egg. The final grade classification will be the lower of the two grades.

Egg Number	Exterior Quality Grade	Interior Quality Grade	Final Grade
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

EGGS

Weight Classification Worksheet

Place a check (✓) in the column which indicates the correct classification for each egg.

Egg Number	Jumbo	Extra Large	Large	Medium	Small	Peewee
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

PLANT SCIENCE
Germination

Upon completion of this activity, you will be able to determine if seed will grow, explain the process of germination, and name at least four occupations in which plant science skills are useful.

Planning to plant a garden? a flower bed? a field of corn? Or maybe you'd like to plant poison ivy in a former friend's backyard. How can you be sure that seeds you plant will grow?

Mary Mudflat had a green thumb. Everything she planted seemed to thrive. She was especially proud of the huge watermelons she grew one summer. Since they were so big and delicious, she decided to save seeds from them to plant the next year. The following spring, Mary plowed and fertilized a much larger garden plot. She had plenty of seeds and she knew she could sell all the melons she produced.

When planting time came, Mary carefully planted the seed in moist soil on the date recommended by experts and waited...and waited...and waited. Nothing happened! The seeds she had so carefully saved were absolutely no good!

Poor Mary learned a lesson you can avoid.

Ask your instructor for a grain of corn and a bean (or a peanut). Don't eat them. We're going to study them for a few minutes.

Look at the corn first. Every seed consists of a "baby" or embryo plant, a supply of food for that plant, and one or more seed coats that surround the young plant and its food supply.

Can you tell where each of these three parts is in the grain of corn?

With a knife you can carefully remove the seed coat (that's the part of popcorn that gets between your teeth) and more clearly expose the embryo and food supply (called the endosperm).

Notice that the embryo is soft (it's a baby!). Corn oil you find in the grocery store is made from embryos.

Scrape the endosperm with your knife. The white powder you see is the same as you buy in a box of cornmeal at the grocery store. It is also used in some brands of face powder.

****

If a corn seed is kept moist and at a temperature of 60 or 70 degrees F., the seed absorbs moisture and the embryo will begin to grow. In two or three days it will burst out of the seed coat. Tiny roots will appear and grow downward into the soil while stem and leaves emerge at the soil surface.

This process is called "germination." If we want to know if seed will grow, we subject it to a "germination test."

Not all plants emerge from the soil in the same way. Let's look at the bean (or peanut) for a moment. The seed coat (the red "skin" on the peanut) can be scraped off to expose the food supply (starchy in the bean, oily in the peanut). Now break the seed into its two halves. Would you believe that each half is a leaf? That's right!

When the seed germinates, these two "seed leaves" are pushed and pulled out of the soil. If you look closely at the embryo (you may want to use a magnifying glass), you can see the true "baby" leaves.

When seeds of this type are kept moist and at a reasonably warm temperature, the seed absorbs moisture and swells; the root breaks through the seed coat and grows downward into the soil; then the plant stem begins to grow upward and pulls the seed through the soil surface; and the "seed leaves" open and true leaves develop.

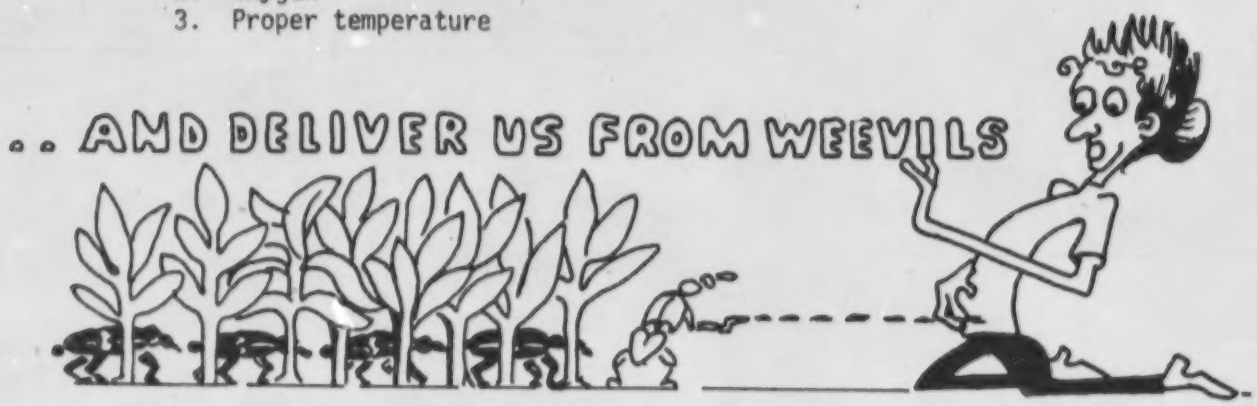
Germination has occurred!

****

Want a puzzler? Seeds are placed in the soil rightside-up, upside-down, and any-which-way. How do the roots know which way is down? And how do leaves know which way it is to the soil surface?

If a seed is "alive" it will germinate if it has (1) moisture, but not too much as the seed also needs (2) oxygen, and (3) proper temperature. These are the only three conditions required for germination:

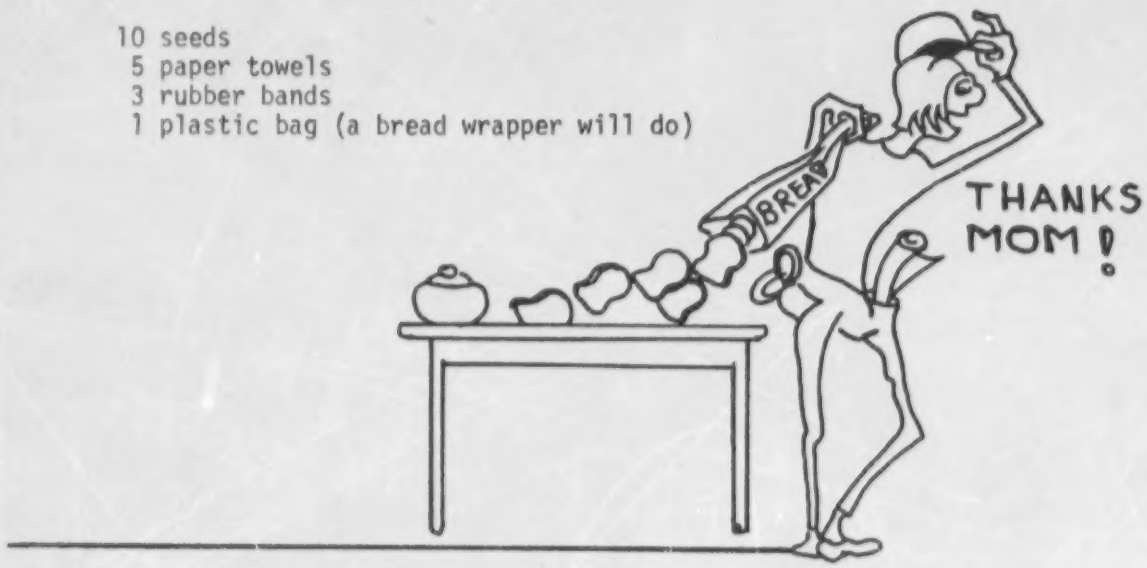
1. Moisture
2. Oxygen
3. Proper temperature



Remember Mary Mudflat and her watermelon problems? Apparently her seeds were not "alive" when she planted them. By neglecting to test her seeds for germination, she lost a watermelon crop. Poor girl. Let's not let that happen to us. Here's how to make a simple germination test.

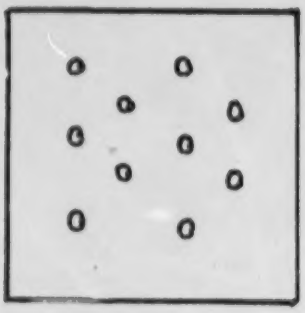
Ask your instructor for 10 bean or corn seeds (for field planting, 100 seeds are normally tested). You will also need five paper towels, three rubber bands, and a plastic bag. Got that?

10 seeds
5 paper towels
3 rubber bands
1 plastic bag (a bread wrapper will do)



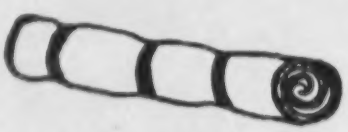
Lay out the paper towels on a flat surface, one on top the other to make a pad five paper towels thick.

Place seeds on the pad. Keep seeds two inches in from the edges and distribute them over the surface.



Begin at one end of the towels and roll them up carefully, but not tightly, keeping the seeds in place.

When the pad is completely rolled up, slip a rubber band around each end and another around the center of the tube. Rubber bands need not be tight.



Put the tube (it's called a "rag doll") in lukewarm or cold water until the towels are thoroughly wet. Remove from water and allow to drain for several minutes.

Slip the tube in a plastic bag or bread wrapper and close the end. The plastic bag keeps the rag doll from drying out.

Store the rag doll at room temperature. Seeds will germinate (if they are going to) in 4 or 5 days.

Now we wait...

After 4 or 5 days, remove the rag doll from the plastic bag. Carefully unroll the rag doll.

What has happened?

If seeds were viable (alive), some or all of the seeds will have formed roots and stems. (You may want to peek at the seeds each day to observe the germination process.)

Count the seeds which have germinated. To find percentage of viable seeds, divide the number of those which have germinated by the total number of seeds tested (10), and convert the decimal to percentage.

$$\frac{\text{Number of seeds germinated}}{\text{Number of seeds tested}} \times 100 = \text{germination percentage}$$

For example, if you found that 6 seeds of the 10 tested had germinated, the germination percentage would be:

$$\frac{6 \text{ germinated}}{10 \text{ tested}} = .6 \times 100 = 60.0\%$$

What was the germination percentage of your sample?

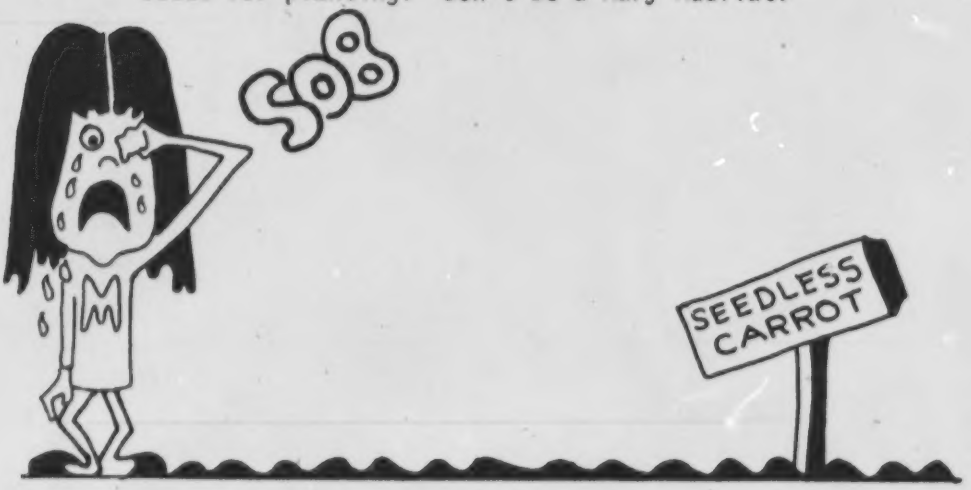
Ask your instructor to verify your answer.

What use can be made of this information?

1. If all or nearly all seeds germinated, you can plant with confidence.

2. If only part of the seeds germinated, seeding rate can be increased to compensate for poor germination.

3. If very few or none of the seeds germinated, get different seeds for planting. Don't be a Mary Mudflat.



SUMMARY

You have experienced a plant science skill which would be useful to

**farmers
**gardeners
**greenhouse workers
**nursery workers
**seed producers
**agronomists

Other occupations involving plant science skills would include plant pathologists (who work with plant diseases), entomologists (who work with insects), landscape and grounds maintenance workers, and plant breeders.

If you enjoy working with plants, ask your instructor and counselor for additional information on plant science occupations and how to prepare for them.

SOIL SCIENCE

SOIL
Acidity & Alkalinity

Upon completion of this activity, you will be able to determine pH of soil and water samples and recognize some causes and effects of soil acidity. You will also be able to name at least three occupations in which soil science knowledge and skills are important.

"What did I do wrong?" wailed Willie Wheatly.

During his first year in vocational agriculture, Willie had decided to produce sweet corn as a project. Willie's Grandpa said he could use the two acres down by the creek, and Willie had worked hard plowing and disking and fertilizing and planting and (whew!) weeding and spraying. The corn had come up well and grew--maybe not as tall as it might have, but it looked pretty good. Now the crop had tasseled, ears had formed, and harvest was about to begin.

Willie was checking the first ears whose silks had dried up. But instead of the big perfect ears of sweet corn Willie expected to find, every ear was curved and filled with grains only on one side. And even that side wasn't filled to the end. What in the world had gone wrong?

Want to guess?

Willie's experience proves once again that, in agricultural production, no vital management practice can be overlooked. Willie had controlled weeds, insects, and diseases. He had planted good seed in well-prepared soil. And he had applied the common fertilizer elements (nitrogen, phosphorus, and potash) at recommended rates. But he had neglected to check soil acidity! Because lime was not applied to correct acidity of the soil, Willie's corn developed poorly and could not be sold. Disaster!!

Problems of soil acidity and alkalinity (the opposite of acidity) are of major concern to anyone who grows plants--the farmer, the nurseryman, the greenhouse operator, the orchardist, the gardener. In fact, everyone who has a lawn or flowerbeds should know something about soil acidity and alkalinity.

What do these terms "acidity" and "alkalinity" mean?

Imagine growing plants in your garden by watering them with lemon juice or vinegar. Would they grow well? Lemon juice and vinegar are examples of mild acids. Neither would be conducive to plant growth.

What would happen if your plants were watered with salt water or household ammonia? These alkaline solutions would definitely kill your plants.

Plants are sort of like people, aren't they? They want water that isn't too salty or sour.

Alkaline soils are normally found in very dry regions. Acid soils are commonly found where rainfall is plentiful. Which condition would you most likely find in West Virginia? Right! Acid soils are a common problem.

In order to intelligently discuss the degree of acidity or alkalinity, scientists have devised a "pH scale." The scale runs from 0 to 14 with 7 being the midpoint (or neutral point). A soil with a pH of 7 is considered to be a neutral soil--it is neither acid nor alkaline. Below a pH of 7 soils are acid in nature; above pH of 7 they are alkaline.

pH 0 to 7 = acid

pH 7 to 14 = alkaline

pH SCALE

Study the pH scale. Which would represent the strongest acid, pH 1 or pH 6? Which would be the strongest alkaline solution, one with a pH of 8 or one with a pH of 13? Acidity is reduced as a solution moves from a pH 0 to pH 7. Alkalinity increases as pH moves from 7 to 14.

****

Let's run a very simple soil test for acidity and alkalinity. You will need:

Several soil samples
A test tube for each sample
Distilled water
Litmus paper
Lime (not the fruit; the kind that comes from limestone)

Ready? Place one inch of soil in a test tube. Fill the tube with distilled water to within 1/2 inch of the top. Shake it up (the soil and water, that is) and let the soil settle to the bottom again. Touch one end of a litmus paper strip to the solution. Is there a color change?

If the litmus paper turned red, the soil solution is acid. If it turned blue, the solution is alkaline. And if it didn't change color at all? You guessed it--it is neutral. Of course we can't tell how strongly acid or alkaline the soil is by this test--only that it is acid, alkaline or neutral.

Repeat the procedure for the other soil samples. What are your results?

Add some lime (about 1/4 teaspoon) to one of the acid samples (one that turned the litmus paper red). Shake it up and allow the soil to settle. Now, test it again.

Does the litmus paper still turn red? With addition of lime, you should now get an alkaline reading. Can you explain why?

This little experiment tells us that soil acidity can be reduced by adding some form of lime to the soil. That, unfortunately, is what Willie Wheatly neglected to do.

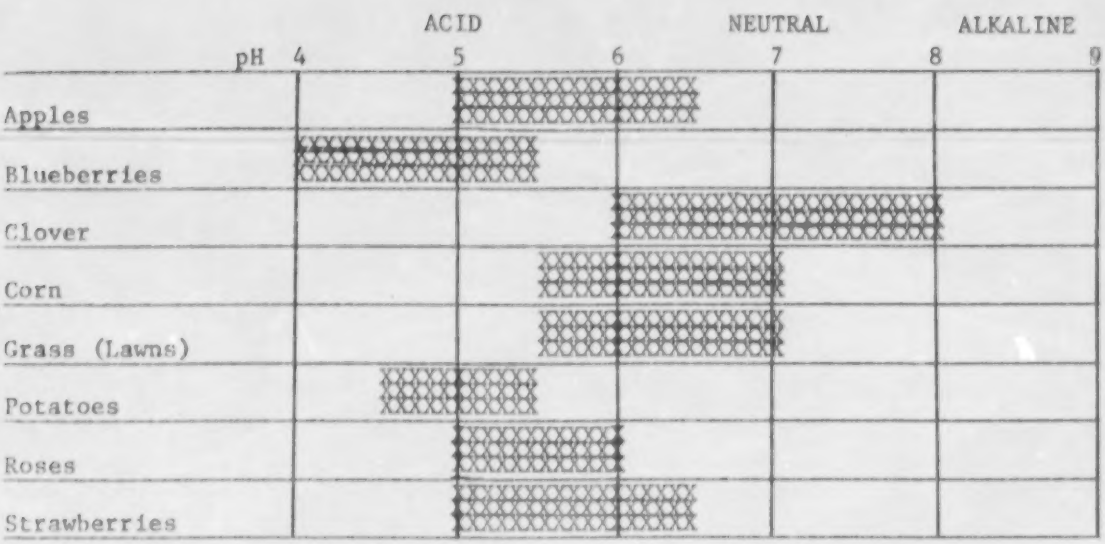
In regions where rainfall is plentiful, lime in soil dissolves in rainwater and is carried down through the soil to the water table. The loss of lime causes acid soils.

Hey! Don't forget to clean up your mess a put things away. Empty your test tubes outdoors, not down the sink (teachers and custodians are hard to get along with when sinks are clogged).

Finished? Good.

Now, we're going to get scientific (are you ready for this?). One would guess that plants prefer a neutral soil. Not true. Most plants (but not all) prefer a slightly acid soil. For every plant, there is a pH range in which it grows best. A few of these are shown in the chart on the next page.

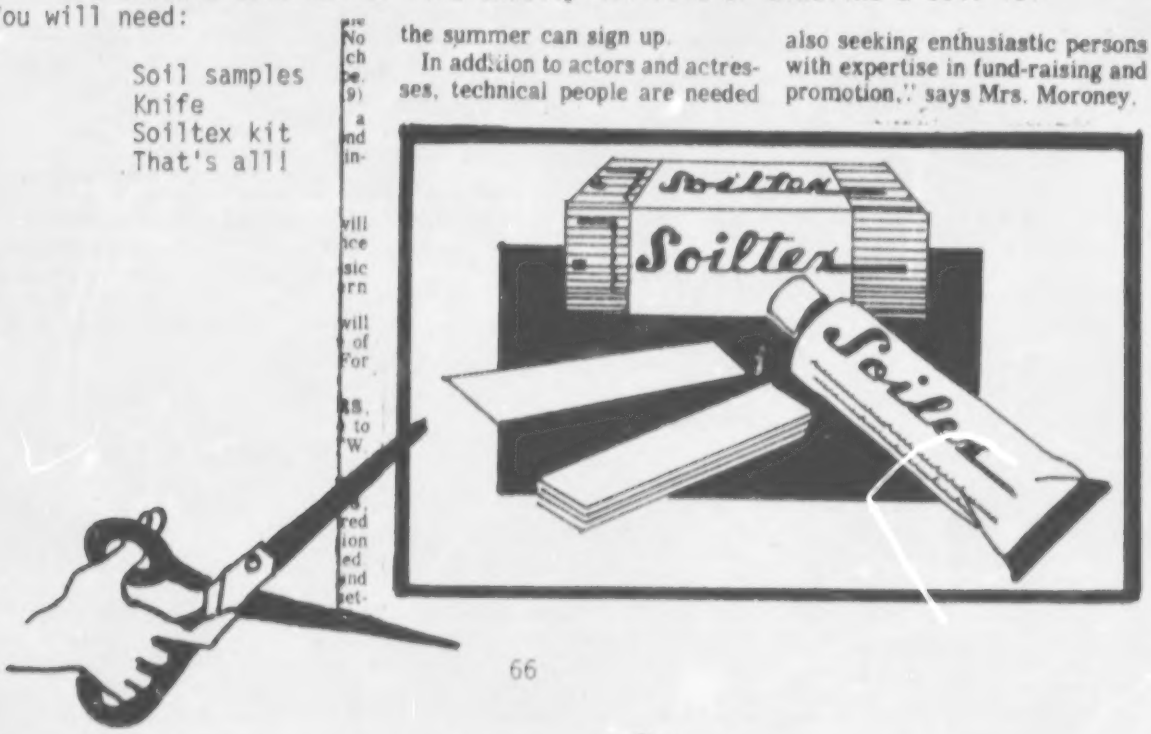
BEST SOIL pH RANGE



As you can see, most plants prefer a slightly acid soil (below pH 7), and each plant grows best within a certain pH range. When Willie Wheatly finally tested his soil, he found it to have a pH of 4.5. What is the best pH range for corn production? If you read the chart correctly, you found that corn prefers a pH range from 5.5 to 7.0. Willie's soil was too "sour" to grow good sweet corn.

Let's run a test now to find exactly how acid or alkaline a soil is. You will need:

Soil samples
Knife
Soiltex kit
That's all!



Soiltex is a liquid indicator that can be used for determining soil acidity as a basis for lime recommendation. Inside the kit are a plastic dropping bottle or tube filled with indicator, waxed papers, and a color chart. Read the directions on the back of the color chart. To use the kit:

a. Fold a piece of waxed paper lengthwise.

b. Fold one end over sideways to hold soil and Soiltex.

c. With a clean knife blade, place a small amount of soil in the folded end of the paper (about ¼ teaspoon).

d. Add 8 to 10 drops of Soiltex solution to the soil.

e. Tilt the paper back and forth very gently for about 30 seconds to allow Soiltex to thoroughly wet the soil.

f. Run the clear liquid back to the nonfolded end of the paper. Don't let it spill.

g. Compare the color of the edge of the liquid with the color chart to determine soil pH.

Test each soil sample and record your pH readings. Have your instructor check your results.

Did you get them right? That was easy, wasn't it? If you want, you can now find lime recommendations for each soil by following the directions found on the back of the color chart.

****

Want to test your own soil for pH? Study the job sheet, "Taking a Soil Sample," at the end of this exercise. Take it home with you and follow the directions. You can take a soil sample from your lawn, garden, orchard, or field. Be sure to follow the directions carefully. That ¼ teaspoon of soil you test represents several hundred <u>tons</u> of soil.

How about a quick check of air pollution in your community? Much of the pollution in air is "washed out" in rainfall. Collect rainwater in a clean container (or melt some snow) and test it for pH with Soiltex. Use the same procedure as in testing soil, but put several drops of rainwater in the waxed paper rather than soil.

What results did you get? Normal rainfall has a pH of about 5.7. If pH is below 5.7, sulfuric acid or nitric acid from industrial pollution is probably responsible. Would acid rainwater affect soil acidity? Yes, indeed! Willie's problems may have been partially caused by acid rainwater. Acid in rainfall can neutralize the lime in soil.

If you are curious, you can also check pH of streams and wells with the Soiltex kit.

Let's see what you have learned from this exercise. Write your answers to the following questions on a piece of paper, then check them against the answers given.

1. In what occupations might people be most concerned with soil pH?

2. Why does soil acidity cause problems?

3. How do soils become acid?

4. What can be done to correct excessive soil acidity?

When you have finished, let's compare answers.

Question 1.

Farmers, nursery operators, greenhouse operators, orchardists, and others (including gardeners and homeowners) would be concerned with soil pH.

Question 2.

Soil acidity affects the growth of plants and production of plant products. Thus, income derived from plant production might be lowered.

Question 3.

Soils become acid in high rainfall areas because lime is dissolved by water and is carried down out of the plant root zone. Acid rainfall also neutralizes the lime in soils.

Question 4.

Soil acidity can be corrected by adding some form of lime to the soil.

SUMMARY

Soils science knowledge and skills are essential to workers concerned with plant growth and production. In addition to occupations already mentioned, fertilizer manufacturers, distributors and salesmen, soil conservation workers, irrigation specialists, and landscape workers must have soil science skills.

If you enjoy working with soils, ask your instructor and counselor for additional information regarding careers in soil science and how to prepare for them.

JOB SHEET

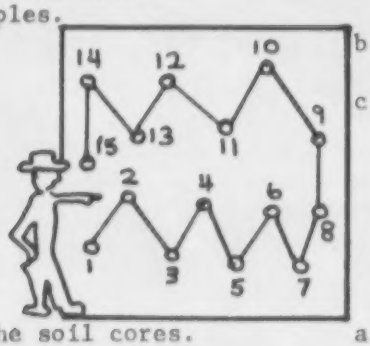
TAKING A SOIL SAMPLE

Equipment and supplies needed:

Soil probe, or soil auger, or spade and knife
Plastic bucket
Paper bag

PROCEDURE

1. Observe plot or field and determine where to take samples.



   a. To get representative soil sample, must take at least 10 soil cores from the plot.
   b. Mentally lay out plot or field to take cores from all parts of the area.
   c. Avoid "freak" areas--old manure piles, ditches, etc.

2. Gather the soil cores.

   a. Scrape off top debris or residue before sampling.
   b. Sample garden or cropland to 6 inch depth; pasture or lawns to 3 inches.
   c. Take one soil core from each sampling site.
   d. If spade is used, remove one shovelful of dirt, then take a slice of soil about one inch thick. With your knife, cut on either side of the center to leave a core about one inch wide on the spade.
   e. Place soil cores in a clean plastic bucket.

3. Mix the sample.

   a. Thoroughly mix the soil cores in the bucket with your hands. Break up clods and lumps as soil cores are mixed.

4. Dry the sample.

   a. Save about one pint of the mixture. Discard the remainder.
   b. Spread the sample on newspaper and allow to dry at room temperature overnight. Crush any small lumps that remain.

5. Bring soil sample to school for testing.

   a. Put dried soil sample in paper bag.
   b. Write your name on the bag.

AGRICULTURAL MECHANICS
Small Engine Maintenance

Upon completion of this exercise, you will be able to perform the following maintenance procedures on small gasoline engines:

Service air cleaners
Check and change oil (4-cycle engines)
Service spark plugs
Clean exhaust ports (2-cycle engines)
Adjust carburetors

If your engine is on a rotary mower, you will be able to sharpen and balance the blade.

You will also be able to name at least four occupations in which agricultural mechanics skills would be useful.

Ferd Fescue was going into business for himself! His dad had given him permission to use the lawn mower and Ferd had lined up four yards to be mowed every two weeks during the summer. At $4 per yard that worked out to more than $300 for the season--more money than Ferd had ever seen. His first mowing schedule had been delayed because it had rained almost constantly for the past two weeks. Grass was really getting tall!

But today was bright and sunny and Ferd figured that if he really worked hard, he could finish all four yards in one day.

Ferd pulled his mower down the street to Mrs. Hubbard's yard. After several pulls on the starter rope the engine roared to life with a cloud of black smoke. Ferd eased the mower into the grass. The engine died. A few more pulls of the starter rope and the engine started again. But all that black smoke! Ferd eased the smoking machine into the grass again. But it didn't seem to have enough power to cut even a little bit at a time.

"Darn," thought Ferd. "If only I had taken time last Saturday when Dad wanted to show me how to adjust and take care of the mower. But no, playing ping-pong with Joe and Marty seemed more important."

After an hour of utter frustration, Ferd gave up. He rang the doorbell and told Mrs. Hubbard he would do the job tomorrow if he could get the mower to run right. How embarassing! And when Mrs. Hubbard said, "If you can't cut the grass tomorrow, maybe I'd better get someone else," Ferd nearly died.

****

What was wrong with Ferd's mower? Why all the black smoke and lack of power? If this happened to you, would you know what to do?

****

This exercise is designed to acquaint you with some of the procedures you can use to keep your mower or other small engines operating properly. Skills in small engine maintenance and repair are useful in many lines of work. For example, the small engine mechanic, the grounds and parks maintenance worker, the landscape aide, the farmer, the forester, and many others must be able to service and repair small engines. Principles of small engine operation are the same as those found in large multi-cylinder engines. A knowledge of small engines can lead into occupations dealing with tractors, trucks and other equipment using large engines.

GETTING ACQUAINTED WITH YOUR ENGINE

There are two common types of small gasoline engines. Most people refer to them as "two-cycle" or "four-cycle" engines. You must identify which one you have in order to service or adjust it properly.

Examine your engine carefully and answer the following questions:

Is there a single tank for fuel and oil?
Are gasoline and oil mixed, then added to the fuel tank?
Is the muffler attached in the middle of the cylinder?

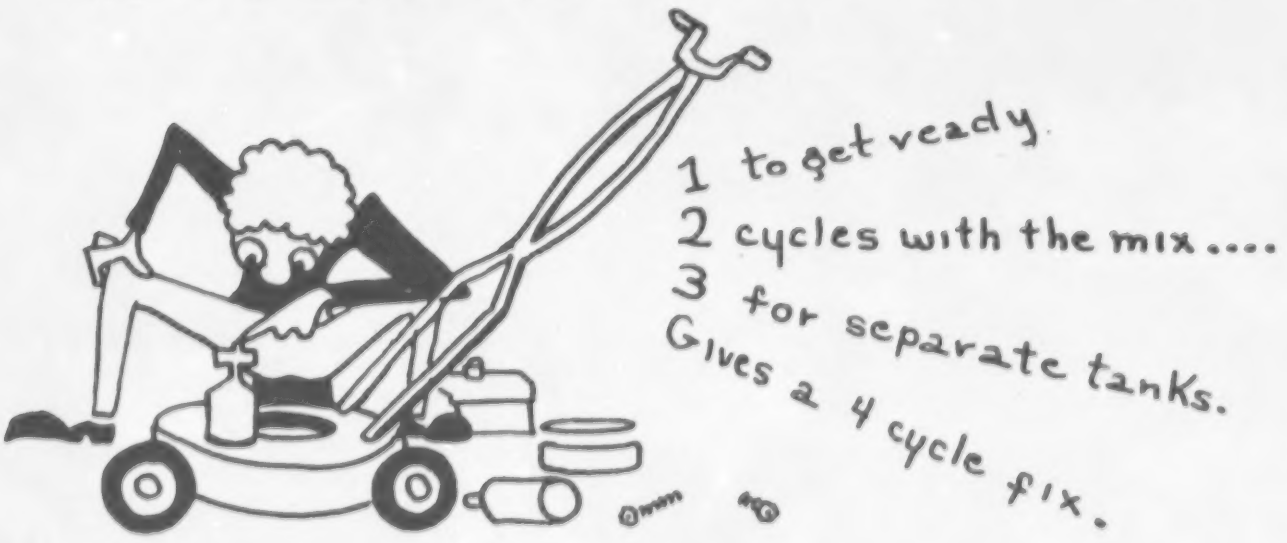
If your answers are "yes" you have a two-cycle engine. Chain saws use two-cycle engines as do most boats and motorcycles and some lawn mowers.

Does your engine have a gasoline tank separate from the oil sump?
Is the muffler attached to the cylinder head (top) of the engine?

If so, you have a four-cycle engine, the most common type found on lawn mowers and garden tractors.

If parts are needed for an engine, it is important to have some other information. Can you find the nameplate on your engine? The nameplate is generally riveted to the cooling shroud or is stamped on it.

Ask your instructor for an Engine Data Sheet. Complete the form and have your instructor check the information for accuracy. Keep the form in your Operator's Manual or in your notebook.



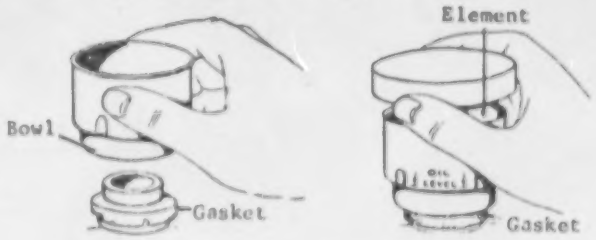
JOB 1

SERVICING THE CARBURETOR AIR CLEANER

An engine uses about 8,000 gallons of air to burn each gallon of gasoline. If air consumed is not cleaned, the engine will soon wear out. If air cleaners are not serviced regularly, dust and dirt will build up, choke the engine, and cause hard starting, black smoke, loss of power, and damage to the engine. Pretty bad, huh?

There are three types of air cleaners used on small gasoline engines. Refer to your operator's manual to find the type you have. If you have no manual, check your engine and determine which type of air cleaner it uses.

a. Oil-bath type--air enters the cleaner under the edge of a cover which sits on top of an oil bowl. A mark on the bowl indicates the level to which oil should be added. Common on garden tractor engines.

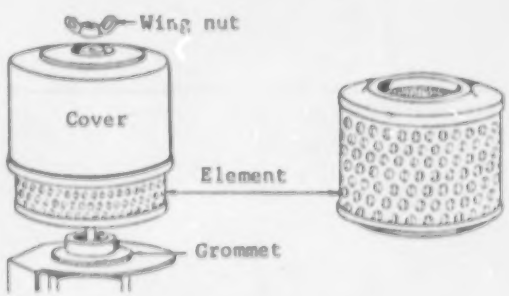


Oil Bath Air Cleaner

b. Oiled-filter type--contains a filter element made of metal foil mesh or polyurethane foam which is coated with oil. There is no oil reservoir. Removal of the filter cover will allow you to see if your engine has an oiled filter.

Oil Foam Air Cleaner

c. Dry-filter type--the filter is usually made of paper, moss, or hair and uses no oil. The element may be in a round container (similar to the air filter on a car) or it may simply be a flat pad (found on most chain saws). Remove the filter cover to see if your engine uses a dry filter.



Dry Element Air Cleaner

OK, which air cleaner type does your engine have? the oil-bath? the oiled-filter? or the dry-filter?

If you said "none of the above," go back to START. Do not pass GO.

Follow directions given in your operator's manual for servicing the air cleaner. If you have no manual, general directions for servicing each of the three types follow:

Oil-Bath Air Cleaner

Tools and materials: Solvent (kerosene or diesel fuel), container for washing parts, clean rags, engine oil.

1. Remove oil bowl or cover and filter.	a. Attached with wire bail or wing nut. b. Hold onto cup--don't spill oil.
2. Cover the exposed air intake.	a. Keep dust out of engine. b. Cover with clean rag.
3. Dispose of dirty oil in bowl.	
4. Wash bowl and filter.	a. Wash in solvent. b. Remove caked dirt from bowl. Scrape with stick if necessary. c. Shake or blow solvent out of filter. d. Wipe bowl dry with clean rag.
5. Refill bowl to proper level.	a. Use light engine oil (like 20 SAE or 10W30). b. Do not overfill.
6. Remove rag from air intake.	
7. Assemble the air cleaner and install.	a. Tighten wing nuts finger tight.

Oiled-Filter Air Cleaner

Tools and materials: Solvent (kerosene or diesel fuel), container for washing parts, engine oil, detergent, clean rags.

1. Clean area around air cleaner.	a. Wipe with clean rag.
2. Remove filter cover.	
3. Remove filter element.	a. Remove gently to avoid tearing a polyurethane (sponge) filter.
4. Cover the air intake.	a. Keep dust out of engine. b. Cover with clean rag.
5. Check condition of filter.	a. Replace polyurethane filter if brittle and crumbly.
6. Clean the filter element.	a. Polyurethane--wash in hot water and detergent. Dry by squeezing. b. Metal mesh--wash in solvent. Shake dry or use compressed air.
7. Oil the filter element.	a. Use light engine oil (10W30 or 20 SAE). b. Polyurethane--apply two tablespoons of oil, distribute by gentle squeezing. c. Metal mesh--dip into oil and shake out excess.
8. Remove rag from air intake.	
9. Install filter element and cover.	a. Tighten wing nuts finger tight.

Dry-Filter Air Cleaner

Tools and materials: Clean rags, detergent and water.

1. Clean area around air cleaner.	a. Wipe with clean rag.
2. Remove filter cover.	
3. Remove filter element.	a. Remove gently to avoid damage.
4. Cover the air intake.	a. Keep dust out of engine. b. Cover with clean rag.
5. Check condition of filter element.	a. Replace if damaged (bent, torn, crushed).
6. Clean the filter element.	a. Paper--tap on flat surface to remove dirt. b. Moss or fiber--wash in detergent and water. Shake dry.
7. Remove rag from air intake.	
8. Install filter element and cover.	a. Tighten wing nuts finger tight.

****

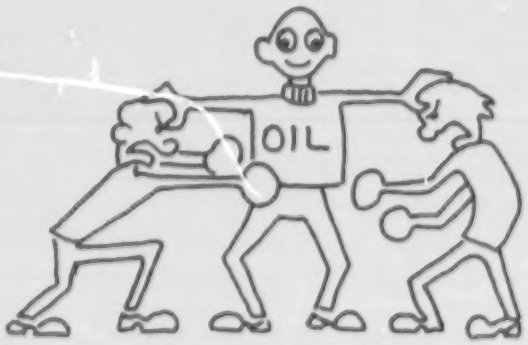
You have now finished servicing the carburetor air cleaner. It should be serviced after every 10 to 15 hours of engine operation. More frequent service is necessary if the engine is working in extremely dusty conditions.

JOB 2

CHECKING AND CHANGING OIL
(4-cycle engine)

Keeping a 4-cycle engine full of clean oil of recommended type and grade is one of the most important jobs of the operator. Oil serves several functions in the engine:

a. Oil reduces friction between moving parts.
b. Oil reduces heat by reducing friction.
c. Oil cleans--dirt is suspended in the oil.
d. Oil prevents corrosion.
e. Oil increases power by reducing friction and sealing piston rings.



REDUCES FRICTION BETWEEN MOVING PARTS.

Quite a list, isn't it? Obviously an engine that runs out of oil is doomed to failure.

Your job?

**Keep oil at the proper level (check it every 2 or 3 hours).
**Use the type and grade of oil recommended by the manufacturer.
**Change oil as recommended (after about 25 hours of operation).

Your operator's manual will tell you the type and grade of oil recommended by the manufacturer. Most will recommend an MS oil SAE 30 for operation in temperatures above freezing. (MS is a heavy-duty oil; SAE refers to oil thickness or viscosity.)

If yours is a 4-cycle engine, follow procedures outlined in your operator's manual to check and change oil. If you have no manual, follow the general directions given in the following job sheets.

Don't forget to check the oil level each time you use the engine. And change the oil after every 25 hours of operation.

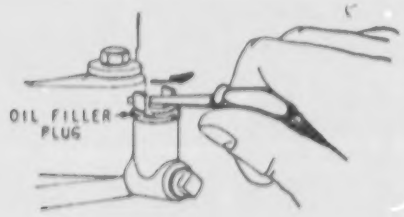
Checking Crankcase Oil Level

Tools and materials: Clean rag, oil, funnel with flexible spout or oil measure.

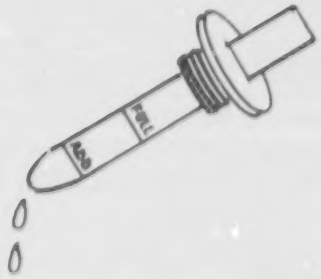
1. Locate oil-filler plug or cap.

2. Clean dirt from around filler plug.
   a. Keep dirt out of crankcase.
   b. Wipe clean with rag.

3. Remove filler plug or cap.



4. Check oil level.



   a. If engine has dipstick:
      1) Remove dipstick.
      2) Wipe dipstick with clean rag.
      3) Reinsert dipstick as far as it will go without attaching the plug or cap.
      4) Remove dipstick and check oil level.
   b. If engine has no dipstick, oil should come to top of filler hole or to a mark or slot that indicates oil level.

5. Add or change oil.
   a. If oil is low and it is nearly time to change it, do not add oil--drain and refill with fresh oil (see next job sheet).
   b. If oil is added, do not overfill. Add type and grade recommended by manufacturer.

6. Replace oil-filler plug or cap.

Changing Crankcase Oil

Tools and materials: Clean rags, open-end wrenches, funnel or oil measure, oil, drain pan.

1. Start and operate engine until warmed up.
   a. Start and run outdoors or use an exhaust hose inside.
   b. Operate about 3 minutes at half-throttle.
   c. Warm oil drains easier and removes more contaminants.

2. Stop the engine and remove spark plug wire from plug.
   a. Prevent accidental starting.

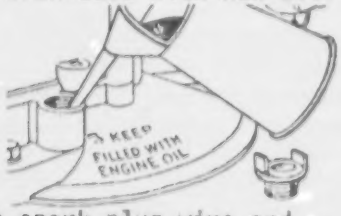
3. Locate drain plug.
   a. Outside edge of oil sump base or under the oil sump (may be beneath a mower engine).

4. Clean dirt from around drain plug.
   a. Keep dirt out of crankcase.
   b. Wipe clean with rag.

5. Remove drain plug and drain oil.
   a. Use open-end wrench.
   b. Turn counterclockwise.
   c. Catch oil in drain pan.
   d. Allow to drain for 5 minutes.

6. Replace drain plug.
   a. Tighten securely.

7. Refill crankcase with new oil.
   a. Use type, grade, and amount recommended by manufacturer.
   b. Do not overfill.
   c. Be sure funnel or measure is clean.
   d. Wipe away oil spilled around oil filler plug.
   e. Replace filler plug.



8. Connect spark plug wire and start engine.
   a. Run 1 to 2 minutes.

9. Stop engine.

10. Recheck oil level.
    a. If not full, add oil to proper level. Do not overfill.

JOB 3

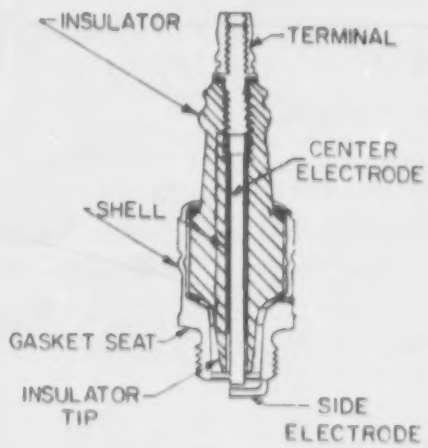
SERVICING SPARK PLUGS

Engine hard to start? Check the spark plug. This little rascal is often the cause of engine starting difficulties. And no wonder! It does its work under the most terrible conditions possible.

The spark plug ignites the fuel and air mixture in the engine cylinder. Each time the fuel-air mixture ignites, an explosion occurs. The plug end must not only suffer the effects of constant explosions, but it operates in a heat range of 800 to 1,600 degrees F. Talk about punishment!

As you can see in the diagram, a spark plug is made up of a steel outer shell to which a side (ground) electrode is attached; and a porcelain insulator which supports the terminal and center electrode.

When current is produced by the magneto (located under the flywheel), it travels through the spark plug wire or cable, into the plug terminal, through the center electrode, and jumps the gap between the center electrode and ground electrode. When current jumps the gap, a spark is produced which ignites the fuel-air mixture in the cylinder.



SPARK PLUG

What happens if spark cannot jump the gap? Right! The engine will not run.

More often, though, you'll find plugs that produce a weak spark. The engine may run (but not as well as it should) but it will be difficult to start and may lack power. Weak spark may be caused by:

**Fouled plugs. Oil or lead deposits on the plug tip.

**Cracked or pitted porcelain. Current follows the path of least resistance. If the insulator is cracked or pitted, current "shorts" out to nearby metal.

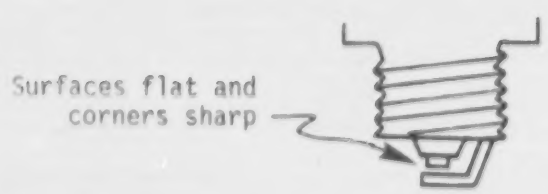
**Wear. A new plug has square edges on the electrodes. In use, electrode edges become rounded and the gap between electrodes increases. Both conditions cause weak spark.

Because of these potential problems, spark plugs should be checked and serviced after 50 to 100 hours of engine operation, more often if starting troubles occur. A general guide to spark plug servicing follows:

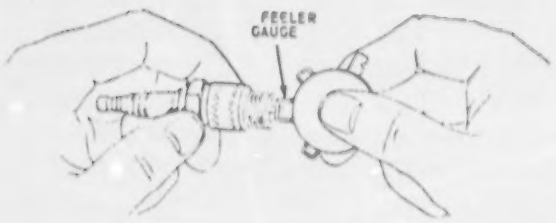
Servicing Spark Plugs

Tools and materials: 3/4" and 13/16" spark plug deep sockets and T-handle or ratchet drive, wire feeler gage, ignition file, wire brush, pen knife, solvent (mineral spirits, kerosene, or diesel fuel), small paint brush, clean rags.

1. Disconnect spark plug wire from plug terminal.
   a. Grasp connector and pull straight up from plug terminal.
2. Loosen plug one or two turns.
   a. Use deep socket.
   b. Hold socket squarely over plug.
   c. Turn counterclockwise.
3. Remove dirt from around spark plug base.
   a. Brush away dirt with small paint brush.
4. Remove the spark plug and gasket (some plugs have no gasket).
5. Check condition of plug.
   a. If insulator is cracked or pitted, install new plug (proceed to Step 8).
   b. If ground electrode is badly worn, install new plug (go to Step 8).
6. Clean the plug.
   a. Soak plug in solvent a few minutes. Wipe dry with clean rag.
   b. Clean threads with wire brush. Do not brush insulator top or tip.
   c. Use small knife blade to remove deposits in shell and on insulator tip. Avoid scratching or chipping insulator around center electrode.
   d. Blow loose materials from plug. Protect the eyes if compressed air is used.
7. File the electrodes.
   a. Use plug gage to bend ground electrode away from center electrode. Bend enough to easily insert ignition file.
   b. File each electrode until surfaces are flat and corners are sharp.



8. Set the plug gap.



a. Determine proper gap from operator's manual or plug chart. (Most are set at .025 inch, but some are set at .030, others at .020.)
b. Bend ground electrode to original position. Use plug gage to bend ground electrode.
c. Check gap with wire feeler gage. Gage should not have to be forced between electrodes, neither should it be completely free.
d. Adjust gap until gage will slide between electrodes with little friction.

9. Replace gasket and plug.

a. Tighten plug with fingers, then
b. Tighten 1/2 turn with deep-socket.
c. Hold socket squarely over plug.

10. Reattach spark plug wire to plug terminal.

****

And that's all there is to that job. If the spark plug has been cleaned and hard starting persists, replace the plug with a new one. Sometimes there are cracks in the porcelain that cannot be seen with the naked eye.

It's a good idea to always keep a spare spark plug on hand.

JOB 4

CLEANING EXHAUST PORTS
(2-cycle engine)

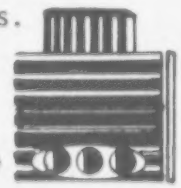
Two-cycle engines sometimes lose power or fail to operate because of carbon build-up in exhaust ports. You may have noticed that 2-cycle engines create much more blue or gray smoke than do 4-cycle engines. Blue smoke occurs because oil, which is mixed with gasoline, is being burned in the engine. When oil burns, carbon is produced. Some of the carbon "sticks" to the exhaust openings and inside the muffler. When carbon deposits build up too much, the engine loses power (because exhaust cannot escape from the cylinder) and the engine becomes hard to start or will not start at all.

Can you find the muffler on your engine? Is yours a 2-cycle engine? OK, here's how to clean the muffler and exhaust ports:

Cleaning Exhaust Ports

Tools and materials: 8" or 10" standard screwdriver, 3/8" drive socket set, solvent, clean rags, wooden scraper.

1. Disconnect the spark plug wire.	a. Avoid accidental starting.
2. Remove the muffler.	
3. Rotate crankshaft until exhaust ports are covered by the piston.	a. Keep carbon and dirt out of cylinder.
4. Clean the exhaust ports.	a. Use a wooden scraper to dislodge and remove carbon. b. Never use a screwdriver, knife, or other metal tool--you may scratch the piston or damage exhaust port edges.
5. Clean the muffler.	a. Soak and wash in solvent. b. Shake and wipe dry.
6. Replace the muffler.	
7. Reconnect spark plug wire.	



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On most 2-cycle engines, carbon build-up is not a serious problem before 200 hours or more are logged on the engine. But if you notice a loss of power or hard starting, this is one of the problems to suspect.

JOB 5

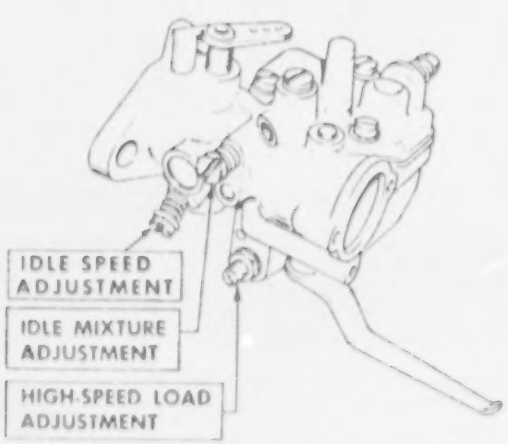
ADJUSTING THE CARBURETOR

The carburetor's job is to mix fuel and air in the proper proportions and regulate the amount of the mixture going into the engine. Fuel-air ratio is controlled by adjustable needle valves. Needle valve settings may change due to normal wear and vibration. A carburetor out of adjustment may result in:

a. A lean fuel-air mixture which can cause hard starting, overheating, and engine damage.

b. A rich fuel-air mixture, which can cause excessive fuel consumption, black smoke, and fouling of spark plugs (hard starting and loss of power again).

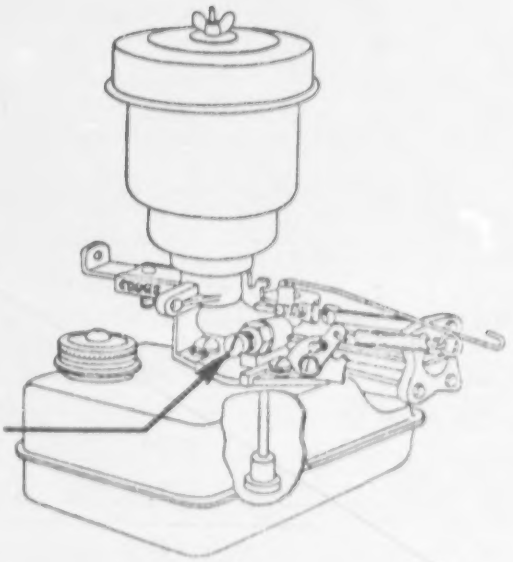
Most carburetors have two adjustable needle valves, one to adjust fuel-air ratio at idle speed and another at high speed. Sometimes these are called "idle valve" and "needle valve."



(a)

(b)

Some carburetors have a high speed (run) adjustable needle valve but no idle mixture needle valve. These are most often found on 2-cycle engines and on carburetors which are mounted directly on top of the fuel tank (known as suction feed carburetors).



Examine the carburetor on your engine. Does it have two adjustable needle valves or only one?

If your engine has two needle valves, can you tell which is for idle mixture and which is for high speed (load) mixture? A hint--the idle valve is generally nearest the engine. If you have no operator's manual, check with your instructor to be sure.

If you have located the needle valve or valves, and have checked the oil and serviced the air cleaner and spark plug, you're now ready to adjust the carburetor.

Follow directions given in your operator's manual on carburetor adjustment, or carefully follow the steps in the general guide which follows:

IDLE MIXTURE VALVE

1. Run engine at idle speed.	a. Engine warm. b. Adjust idle speed stop screw, if necessary.
2. Turn idle adjusting valve clockwise until engine begins to slow down.	a. Turn valve 1/8 turn at a time, wait a few seconds until engine adjusts to new fuel-air mixture.
3. Turn idle adjusting valve counterclockwise very slowly until engine runs smoothly.	
4. Accelerate engine speed quickly.	a. Idle adjustment may affect high speed performance. b. If engine backfires or emits black smoke, readjust load valve as previously described.

****

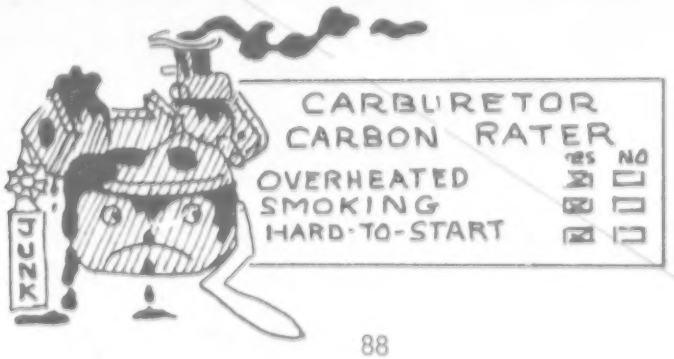
Carburetors seldom give trouble as long as:

a. Clean fuel is used, and

b. Fuel is completely drained from the tank and carburetor during winter storage (operate the engine until it runs out of fuel).

Carburetor adjustment should be checked every 250 hours of operation or whenever symptoms indicate a carburation problem (overheated, smoking, or hard-to-start engine).

Be sure to service the air cleaner, exhaust ports, and spark plug before carburetor adjustments are made.



JOB 6

SHARPENING ROTARY LAWN MOWER BLADES

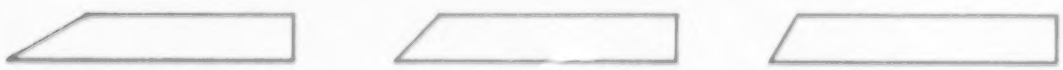
Your engine should run smoothly now that you have serviced and adjusted it. If it drives a lawn mower blade, there's one more job to do to assure good work with the least effort. What is that job? Right! Let's sharpen the blade.

Blades can be sharpened with a file or a grinder. Since every mower owner can afford a file, this exercise will help you to learn sharpening procedures with a file.

In filing the blade, keep three things in mind:

1. The cutting edge must be sharp.

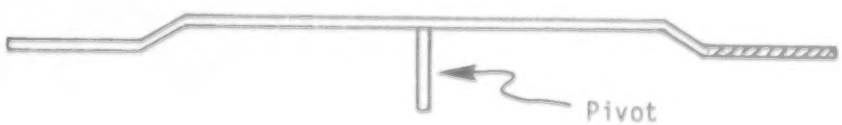
2. The bevels should be filed to a reasonable angle--about 45 degrees. At this angle, the blade will cut well and dull slowly. At less angle (say 30 degrees), the blade will also cut well but it will dull quickly. At a blunter angle, like 60 degrees, the blunt edge will not shear easily.



30 Degrees 45 Degrees 60 Degrees

3. Not only must the blade be sharp and bevels filed to a reasonable angle, but the "balance" of the blade must be maintained. From the center of the blade, each end must weigh the same. If the two ends differ in weight (an out-of-balance blade), the blade will cause vibration and rapid wear on crankshaft bearings.

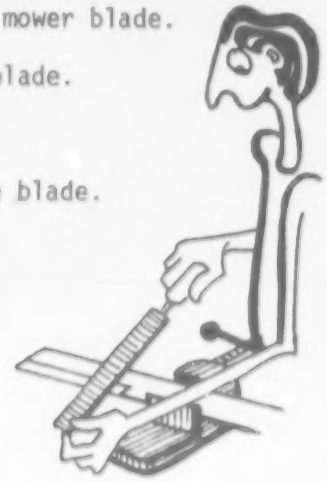
The blade is balanced by using a blade balancer or by placing the center hole over a pivot (like an edge of 1/8" or 3/16" metal). If one end is heavier than the other it will drop. The bevel of the heavy end is filed until the blade balances on the pivot.



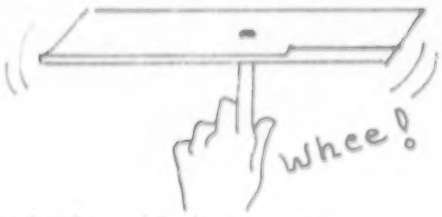
Sharpening Mower Blades

Tools and materials: Socket wrenches, wire brush, 12" mill file, vise.

1. Disconnect spark plug wire.
   a. Prevent accidental starting.
2. Remove the mower blade.
3. Clean the blade.
   a. Use wire brush to remove caked dirt and rust.
   b. Dirt on blade will affect balance.
4. Sharpen the blade.



   a. Clamp blade flat in vise near one end, bevel side up.
   b. Use 12" mill file to sharpen.
   c. Maintain original angle of bevel, or file to approximately 45 degree angle.
   d. Blade is sharp when wire edge can be felt along bottom edge of bevel.
   e. Reverse blade in vise and file opposite bevel.
5. Balance the blade.



   a. Use blade balancer if available, or
   b. Clamp strip of 1/8" or 3/16" metal in vise.
   c. Place center hole of blade directly over the metal strip.
   d. If one end of blade drops, file more from bevel of that end.
   e. Repeat until blade balances.
6. Replace blade on mower.
   a. Beveled edges up.
   b. Tighten bolt(s) securely.
7. Reconnect spark plug.

****

Check sharpness of your mower blade after 20 or 30 hours of operation. A dull blade wastes time and fuel and will cause browning of tips of grass blades. A dull blade bruises grass causing the end to die back.

SUMMARY

You have now experienced some agricultural mechanics skills useful to workers in many walks of life. But the agricultural mechanics field is much broader than just gasoline or diesel engine work.

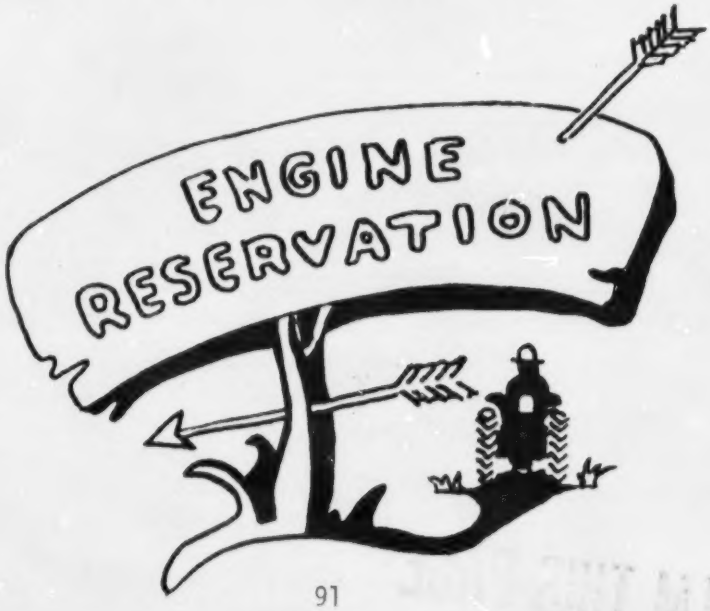
Agricultural engineering and mechanics occupations encompass five broad areas:

1. Agricultural power
2. Agricultural machinery
3. Agricultural electrification
4. Agricultural structures and conveniences
5. Soil and water management

Each of these five areas employs workers ranging from the semi-skilled person to the professional engineer.

A few of the jobs available in agricultural engineering and mechanics occupations would include tractor mechanic, machinery assembler, design engineer, salesperson, vocational agriculture teacher, irrigation engineer, soil conservation aide, rural electrician, electrician's helper, carpenter, equipment mechanic, and equipment operator. There are hundreds of others.

If you enjoy working with engines, machines, building construction, electricity, soil conservation, irrigation, or drainage, there is an occupation in agricultural engineering or mechanics available to suit your talents and abilities. Visit with your instructor and counselor to determine how you can prepare for a career in one or more of these areas.



ENGINE DATA SHEET

Make of Engine (Manufacturer): _____

Model Number: _____

Serial Number: _____

Specification Number: _____

Horsepower: _____

Type of Engine:

( ) 2-cycle

( ) 4-cycle

Operating Position of Crankshaft:

( ) Vertical

( ) Horizontal

( ) Multi-position

Notes:

NATURAL RESOURCES

Forestry Measurements

Upon completion of this activity, you will be able to measure height, diameter, and board foot volumes of standing trees, and name at least four occupations in which natural resources and forestry skills would be useful.

Wendy Woodstock was 16--and rich! Well, almost. Her Great-Uncle Wooster, whom she hardly knew, had died and left Wendy 87 acres of timber land a few miles from the farm where Wendy and her parents lived.

Only a few days after Uncle Wooster died, a man had offered Wendy $4,000 for the timber on her newly-acquired land. "A good offer," he had said. Wendy had told him she would have to think about it, although she could hardly wait to phone him and accept his offer.

Then, two days later, another gentleman came by and offered Wendy $3,000 for the timber. But when she told him she had been offered $4,000, he immediately raised his offer to $5,000.

Now Wendy was confused. Just how much was the timber worth? How could she find out?

The following Monday, Wendy asked her vocational agriculture teacher, Mr. Goodguy, what she should do. Mr. Goodguy suggested that Wendy cruise the timber and find out for herself how much was there. "But I can't drive through all those trees," Wendy objected.

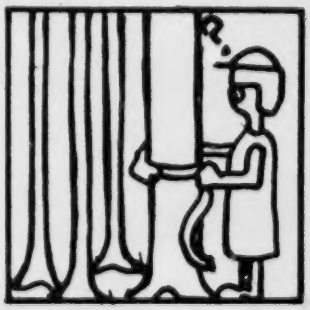
"No, no," laughed Mr. Goodguy. "Cruising means to measure a sample of trees in order to estimate the total volume of timber on the land. Then you can get an idea of the value."

"It wouldn't be too hard to measure the thickness of the trees," commented Wendy, "but I don't believe I could climb any of them to find out how tall they are."

"It's really not that difficult," explained Mr. Goodguy. "I can show you how to do it and you won't have to climb any trees. But if you prefer, you can ask the County Forester to cruise your timber."

Wendy thought a while. Then she said, "If you'll show me how, I'd rather do it myself. Maybe I can get a job with a lumber company next summer if I know how to cruise timber."

"That's a possibility," agreed Mr. Goodguy. "Let's get started."



DO NOT FILM THIS PAGE

This exercise is designed to acquaint you with part of the job of the timber cruiser, one of the many occupations associated with the forestry and wood industries. Timber cruising skills are also useful to landowners, timber buyers, foresters, forestry aides, and others working in the nation's forests.

PACING

How long is a chain? Silly question, isn't it? Not really. Distance measures in forestry work are generally given in terms of "chains," one chain being 66 feet or 20.12 meters. There are 80 chains in one mile.

Because many measurements in forestry work need not be absolutely accurate, foresters have adopted a system called "pacing" to estimate distance with reasonable accuracy. If you can walk, you can learn to measure distances by pacing. To learn pacing, you will need:

**a chain tape or a 100 foot tape measure
**two wooden stakes or plastic marking flags
**a hammer or mallet (if wooden stakes are used)

A "pace" in forestry work means two steps. Start walking with the left foot and count one pace each time your right foot hits the ground. Pacing will be most accurate if learned in the forest. If you can't get to the forest for this exercise, at least stay off sidewalks and streets.

To learn pacing:

1. Drive one stake (or flag) in the ground deeply enough that it will stand up.

2. With the chain tape or tape measure, measure a distance of 66 feet across the slope (not up or down the slope).

3. Drive the second stake (or flag) in at the 66 foot mark.

4. Beginning at one stake, lead off with the left foot and count each time your right foot hits the ground. Walk as you normally would in the woods. You should find from 9 to 14 paces between stakes.

5. Pace between stakes several times to see if the number of paces changes. Be sure to walk at a normal speed.

Move the stakes to another location. Check your paces in the new location. Did the number change?

How many paces are in a chain?

Remember that figure.

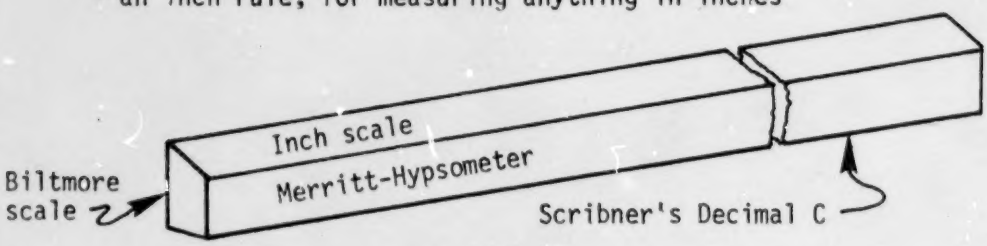
CRUISING

The purpose of cruising is to determine diameters and heights of a sample of trees from which volume of lumber can be estimated. If lumber volume is known, then forest value can be found.

Diameters and heights of standing trees can be measured with a cruiser's stick (commonly called a Biltmore stick). Each of the four sides of the Biltmore stick is marked with a different scale.

Ask your instructor for a Biltmore stick. On the four sides you will find:

- **the Biltmore scale, for determining tree diameter
- **the Merritt Hypsometer scale, for finding tree height
- **the Scribner's Decimal C scale, for finding board feet volume of individual logs 16 feet in length
- **an inch rule, for measuring anything in inches



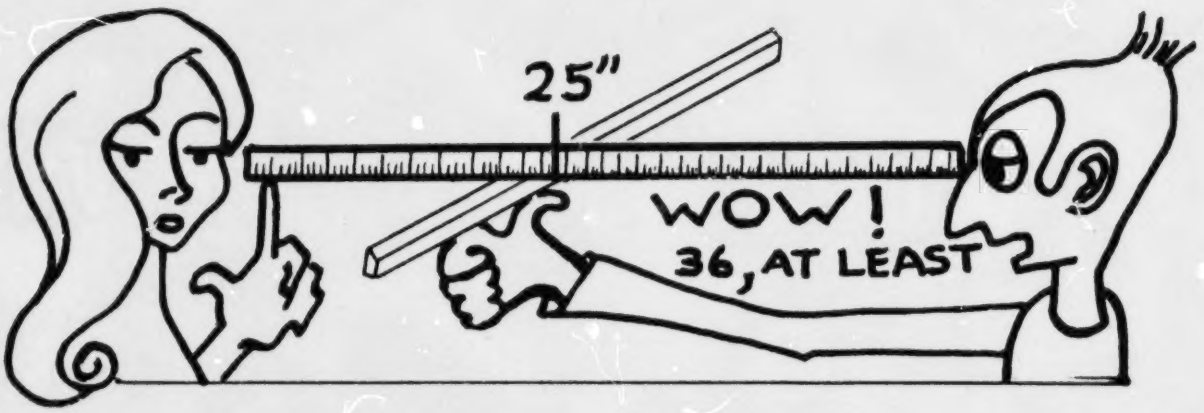
Finding Tree Diameter

Diameter measurements of standing trees are taken with the Biltmore scale at a point 4½ feet above the ground. This point is called tree d.b.h. Tree d.b.h. means tree diameter at breast height.

Use the inch scale of the Biltmore stick to measure 4½ feet (54 inches) on a board or on the wall. When you stand next to it, where does the 4½ foot mark strike you?

Depending on how tall you are, it may be on your chest, in the face, or possibly above your head. Wherever it is, remember the place so that you can locate a point on a tree 4½ feet from the ground.

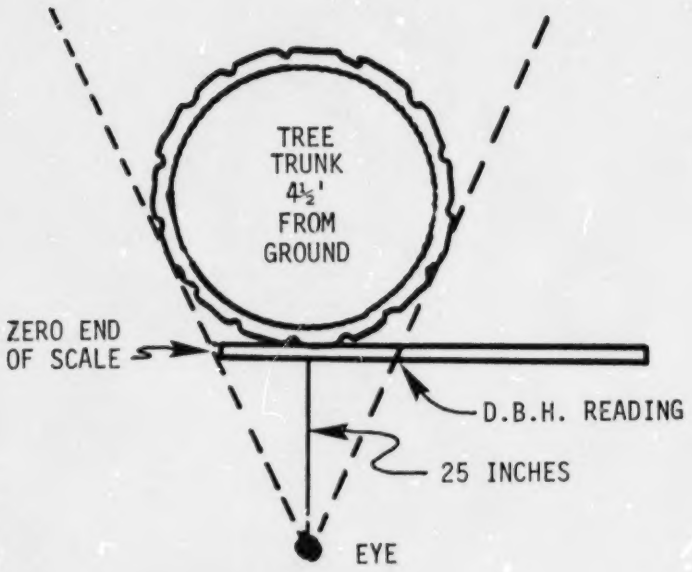
Scales on the Biltmore stick are designed to be read with the stick held 25 inches from the eye. Hold the stick in front of you with one hand while a classmate measures from your eye to the stick. Remember how much you have to bend your elbow, if any, to reach 25 inches. Practice several times to make sure you have it.



If you can find a point 4½ feet from the ground, and if you can hold the Biltmore stick 25 inches from your eye, you're now ready to take d.b.h. readings. You may want to practice on telephone poles, waste baskets, or barrels before you go to the woods.

Here's how to find d.b.h.:

1. Stand on the uphill side of the tree.
2. Place the Biltmore stick horizontally against the tree trunk 4½ feet from the ground with the Biltmore scale exposed.
3. Hold the scale 25 inches from the eye.
4. Sight over the left (zero) end of the scale and align it with the left side of the tree. Close one eye if it helps.
5. Do not move your head. Sight over the scale to the right side of the tree and record the nearest 2 inch scale reading at that point. The number read is tree d.b.h. (Tree d.b.h. readings are in 2 inch increments; 8", 10", 12", etc.)



Your instructor will mark 10 or more trees with plastic flagging and numbers. Measure and record d.b.h. for each tree on the Tree Volume Worksheet which your instructor will give you.

Be sure to

**stand on the uphill side of the tree

**measure at a point 4½ feet from the ground, and

**hold the Biltmore stick 25 inches from your eye.

When you have finished, ask your instructor to check your findings. Were they all right? If so, we're ready to find tree heights.

Finding Tree Height

Foresters measure height of trees in terms of usable 16 foot logs and half-logs (8 feet). The height is usually measured from stump height to an estimated 8 inch diameter at the top of the tree. In hardwood trees, measure to the point where the tree forks at the top.

The Merritt Hypsometer scale is used to determine the number of logs and half-logs in a tree. You may want to practice finding heights of telephone poles or buildings before going to the woods. Here's how to use the scale:

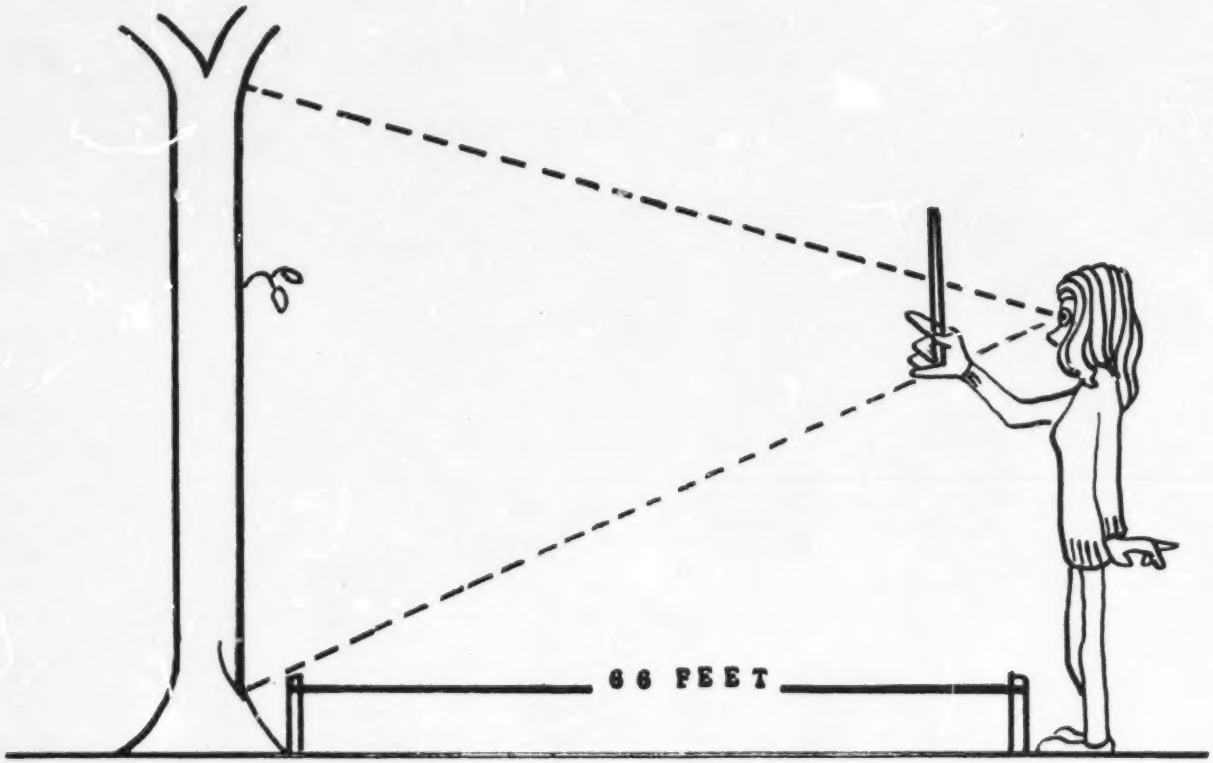
1. Beginning at the base of the tree, pace (remember how to pace?) one chain across the slope (not up or down the slope).

2. Hold the Biltmore stick with the Hypsometer scale facing you, 25 inches from your eye, and perpendicular to the ground. Place your little finger under the stick to support it.

3. Sight under the zero end and raise or lower the stick so that your line of sight is at stump height (about a foot from the ground).

4. Without moving the stick or your head, sight up the stick to where the tree forks or where you have an estimated eight-inch top.

5. Read the left-hand scale (one chain) to the nearest half-log length and record this number. Half-logs are not marked on the scale--estimate them.

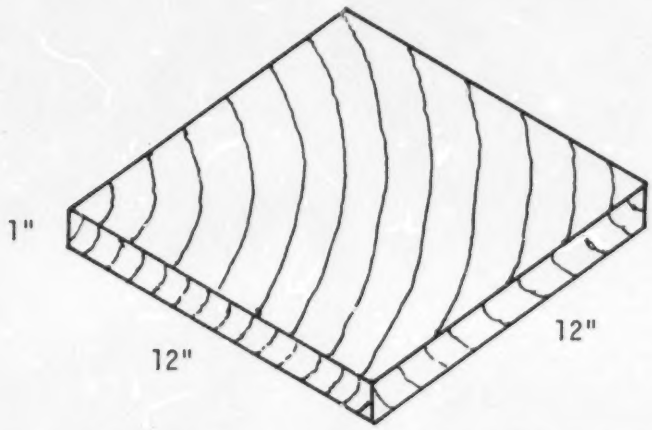


After practice, measure the trees you previously measured for d.b.h. Record your findings on the same Worksheet.

When you have finished, ask your instructor to check your measurements. If they are all correct, you're really cruising!

TREE VOLUMES

Now that d.b.h. and number of usable logs in each tree have been determined, you can find the volume of lumber per tree. Volume is expressed in board feet, a board foot being a piece of wood 12 inches square and one inch thick.



To find volume of each tree, refer to the table below. Find the tree diameter (d.b.h.) in the left hand column, then follow the line to the right to the proper column for number of logs in the tree.

The figure given where the two intersect shows the tree volume in board feet. For example, a 16 inch 3 log tree contains 241 board feet. Can you see how we got that answer?

Tree Diameter (Inches)	Volume (board feet) by Number of Usable 16 Foot Logs						
	1	1 1/2	2	2 1/2	3	3 1/2	4
10	36	48	59	66	73		
12	56	74	92	106	120	137	
14	78	105	132	153	174	187	200
16	106	143	180	210	241	263	285
18	136	184	233	274	314	344	374
20	171	234	296	348	401	440	480
22	211	290	368	434	500	552	603
24	251	346	441	523	605	664	723
26	299	414	528	626	725	801	877
28	347	482	616	733	850	938	1,027
30	403	560	718	854	991	1,094	1,198
32	462	644	826	988	1,149	1,274	1,400
34	521	728	934	1,119	1,304	1,447	1,590
36	589	826	1,063	1,274	1,485	1,650	1,814

Let's practice finding tree volume for a moment. Using the tree volume table, can you find the number of board feet in each of the following trees?

(a) 10 inch 2½ logs
(b) 26 inch 4 logs
(c) 14 inch 2 logs

****

Ready to check your answers? If you found (a) 66, (b) 877, and (c) 132, you're ready to compute volumes of trees you measured.

On your Worksheet you have recorded d.b.h. and height in usable logs. Use the table to find board foot volume for each tree. Record your answer in the right hand column of the Worksheet.

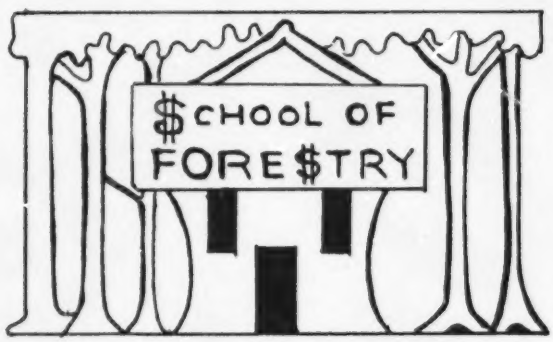
****

When you have finished, you may be interested in finding the value of the trees you measured. Total the volumes in the right hand column. Prices paid for standing timber varies with kinds of trees and lumber demand. Let's say, for example, that mixed timber is worth $60 per thousand board feet. To find the value of your trees, count three digits from the right of your total volume figure and put a decimal point there. Your volume is now converted to thousands of board feet. Multiply that figure times $60 to find total value.

As an example, if your tree volumes added up to 4,780 board feet, the decimal point is placed three digits from the right--4.780 thousand board feet. At $60 per thousand board feet, then

$$4.780 \times \$60 = \$286.80$$

Find the value of your trees at $60 per thousand board feet. Have your instructor check your figures for accuracy.



SUMMARY

You have experienced some skills in cruising which are useful to many persons who work in forests. If this exercise interested you, you may want to learn more about forestry occupations. Interesting and well-paying jobs exist in each of the six areas of forestry occupations:

**Timber production

**Forest protection

**Wood processing and utilization

**Wildlife management (fish and game)

**Recreation and parks

**Forest hydrology (water management)

Other occupations involved in care and use of our natural resources would include:

**Air pollution control

**Water pollution control

**Soil and water conservation

**Strip mine reclamation

Jobs in natural resources and forestry are available to high school and college graduates who prepare for them. If you would like more information on how to prepare for a challenging career in natural resources or forestry, discuss your interests with your instructor and counselor.

TREE VOLUME WORKSHEET

Tree Number	d.b.h.	Number of 16 ft. logs	Volume (board feet)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			